

**ANALYTICAL RESULTS REPORT
for SITE REASSESSMENT**

**UPPER ANIMAS MINING DISTRICT
Silverton, San Juan County, Colorado**

CERCLIS ID# CO0001411347

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1.0 INTRODUCTION

This Analytical Results Report (ARR) for the Upper Animas Mining District Site Reassessment (SR) in Silverton, San Juan County, Colorado, has been prepared to satisfy the requirements of Technical Direction Document (TDD) No. 1008-13 issued to URS Operating Services, Inc. (UOS) under the U.S. Environmental Protection Agency (EPA) Region 8 Superfund Technical Assessment and Response Team 3 (START) Contract No. EP-W-05-050. This report has been prepared in accordance with the EPA “Guidance for Performing Site Inspections under CERCLA,” Interim Final, September 1992, and the “Region 8 Supplement to Guidance for Performing Site Inspections under CERCLA” (EPA 1992, 1993). Field work at the Upper Animas Mining District site included a site reconnaissance in September 2010 and the sampling activities that were conducted during the week of October 25, 2010. Site activities followed the Site Inspection (SI) format and the Generic Quality Assurance Project Plan and the applicable UOS Technical Standard Operating Procedures (TSOPs) (UOS 2005a, b).

The field activities conducted by UOS specifically included the collection of 54 surface water samples, 54 sediment samples, and 14 source soil samples; these sample numbers include field duplicate samples and field Quality Assurance/Quality Control (QA/QC) samples (in addition to the laboratory matrix spike/matrix spike duplicate [MS/MSD]) (Table 1).

The soil and sediment samples were shipped via FedEx to a Contract Laboratory Program (CLP), Routine Analytical Services (RAS) laboratory, ALS Laboratory Group in Salt Lake City, Utah. Soil and sediment samples were analyzed for Target Analyte List (TAL) metals and polychlorinated biphenyls (PCBs). Surface water samples were hand-delivered to EPA Region 8 Environmental Services Assistance Team (ESAT) Laboratory in Golden, Colorado. Water samples were analyzed for TAL metals. This ARR is intended to be used in conjunction with the Upper Animas Mining District Field Sampling Plan (FSP) that was approved by EPA on October 21, 2010, and the Upper Animas Mining District Trip Report (UOS 2010, 2011a).

2.0 OBJECTIVES

Previous investigations in the Upper Animas Mining District identified the tailings piles and adit discharges as sources of contamination, but did not yield conclusive information regarding possible migration of contaminants into the Groundwater Pathway, Surface Water Pathway, and the Soil Exposure Pathway. This SR was performed to determine if any contamination from the Upper Animas Mining District site has migrated into the environment where it is impacting environmental and/or human health

targets. The purpose of this SR was to gather information for the evaluation of this site with regard to the EPA's Hazard Ranking System (HRS) criteria (Office of the Federal Register [OFR] 1990). The specific objectives of this SR were:

- Document and evaluate source areas;
- Evaluate targets for the groundwater, surface water, soil, and air pathways;
- Evaluate non-sampling data documenting past observed releases from site source areas;
- Collect surface water samples to document a release to Cement Creek and the Animas River;
- Collect sediment samples to document a release to Cement Creek and the Animas River;
- Document target locations for fisheries and wetlands; and
- Collect soil (source) samples to characterize potential contaminants at the site and characterize the extent of surface soil contamination that may affect overland water flow to Cement Creek.

3.0 SITE DESCRIPTION

Cement Creek originates high in the rugged San Juan Mountains of southwestern Colorado near the San Juan County and Ouray County line on the south slopes of Red Mountain Number 3 and the north slopes of Storm Peak. Cement Creek begins at an elevation of 13,000 feet above mean sea level (MSL) and flows 7 miles southward to an elevation of 9,305 feet above MSL at its confluence with the Animas River at Silverton, Colorado (Figures 1 and 2) (Colorado Department of Public Health and Environment [CDPHE] 1998). The name Cement Creek probably refers to the iron rich precipitates (ferricrete) that coat and cement the stream bed materials (U. S. Geological Survey [USGS] 2007e). This investigation will focus on the largest sources of unremediated mine waste in Upper Cement Creek (above Gladstone) including the Gold King 7 Level Mine, Red and Bonita Mine, Mogul Mine, Mogul North Mine (also known as the Mogul Sublevel 1), Grand Mogul Mine, Queen Anne Mine, and potentially the Columbia Mine and the Adelphin Mine. These mines will henceforth be referred to as the “upper Cement Creek mines.” This investigation also addressed potential PCB contamination in the aforementioned sources and sediments of Cement Creek and the Animas River.

3.1 SITE HISTORY

The rugged and relatively inaccessible western San Juan Mountains were first prospected by the Baker party, which explored the area around Silverton in 1860. After a treaty with the Ute Indians was revised, mining began in 1874, and George Green brought the first smelter equipment into the area at Baker's Park that year (Silverton Magazine 2009). The extension of the railroad from

Silverton up Cement Creek to Gladstone in 1899 encouraged the mining of low grade ores, and the establishment of a lead-zinc flotation plant in 1917 allowed for the treatment of the low grade complex ores found in the area (USGS 1969). The last producing mine in the area was the Sunnyside Mine, which ceased production in 1991 (USGS 2007c). The closing of the Sunnyside mine occurred after Lake Emma drained into the mine and out the American Tunnel into Cement Creek in 1978. The flood water from the Lake Emma “blow-out” was reported to have flowed down Cement Creek in a 10-foot wall of water that would have transported a large quantity of tailings and other mine waste down Cement Creek to the Animas River (The Silverton Railroads 2009).

Over a 100-year period between 1890 and 1991, mining activities in the Upper Animas River Basin, including Cement Creek, produced the waste rock and mill tailings sources from which contamination spread throughout the Surface Water Pathway. Over 18 million tons of ore were mined from the Upper Animas River Basin area, with more than 95 percent of this being dumped directly into the Animas River and its tributaries in the form of mill waste. Older waste rock piles and stope fillings were reworked and sent to mills as technology allowed lower grade ores to be economically processed. A great deal of abandoned waste was also milled during World War II when many older mining and milling structures were cannibalized for scrap metal. The history of mining and milling in the Cement Creek area can be divided into four eras, each of which produced different types and volumes of mine wastes.

- Phase 1 The Smelting Era (1871-1889). Mines were usually small, mining was done by hand, milling was rarely done, and small amounts of often highly mineralized rock were left in surface dumps. Zinc minerals were preferentially removed from the ore and left in mine dumps because zinc created problems during the smelting process. Total production of the entire Upper Animas River area during this era is estimated to be 93,527 short tons. Very little mine or mill tailings were directly discharged into the area streams (USGS 2007c).
- Phase 2 The Gravity Milling Era (1890-1913). Federal government support coupled with the introduction of higher capacity mining and milling techniques encouraged the mining of lower grade ores. Milling became the predominant ore processing method as ore values dropped and tonnage increased. Large volumes of mine and milling wastes were discharged directly into streams.

Gravity mills recovered as much as 80 percent of the metals; however, zinc, iron pyrite, and some copper compounds were not recoverable, and when discharged into the streams, were easily spread downstream throughout the environment. Between 1890 and 1913 the total production of the entire Upper Animas River area was estimated at 4.3 million short tons (USGS 2007c). Approximately 95 percent of the waste generated during this era was discharged directly into the area streams (USGS 2007c).

- Phase 3 The Early Flotation Era (1914-1935). The increased demand for metals caused by World War I further accelerated the trend to larger scale mining and milling in the area. Ball mill grinding and froth flotation for concentrating ores were introduced, and again most mill tailings were dumped directly into area streams. During this era total production of the entire Upper Animas River area was estimated at 4.2 million short tons, of which only 36,232 short tons were shipped out of the area to be smelted (USGS 2007c).
- Phase 4 The Modern Flotation Era (1936-1991). Mining almost came to a halt during the Great Depression, but mining activity resumed during World War II when many mines and mills were reopened with substantial support from the federal government. In addition to the newly mined material, waste rock from abandoned mines, in both the waste dumps and the old underground stope fills, was reclaimed and processed. Mining and milling processes improved in detail, but still used familiar technology. The major change was the impoundment of mill tailings that began as a result of a 1935 Colorado Supreme Court ruling that required operations to contain mill tailings. Some early attempts to contain mill tailings were not completely successful and resulted in catastrophic releases of mill tailings to area streams. Mining and milling in the Upper Animas River area had substantially decreased by 1953, and all mining and milling activity ceased in 1991. During this era total production of the entire Upper Animas River area was estimated at 9.5 million short tons. All mill tailings were impounded in settling ponds except for an estimated 200,000 short tons of mill tailings that were released into the Animas River area streams. Ore shipments to smelters totaled only 8,148

tons out of the 9.5 million short tons of production during this final era (USGS 2007c).

Reclamation activities have been ongoing in the Cement Creek basin since 1991 when tailings were removed from the Lead Carbonate Mill site. Reclamation work has also been conducted in Gladstone at the American Tunnel waste dump and portal, Herbert Placer settling ponds, and the Gold King 7 Level Mine. Downstream of Gladstone on Prospect Gulch, several mine sites have been remediated, including the Galena Queen Mine, Hercules Mine, Henrietta Mine, and most recently at the Joe and John Mine and the Lark Mine in 2006 and 2007 (Animas River Stakeholders Group [ARSG] 2007). No new reclamation activities were initiated in 2008 or 2009 (ARSG 2009). In 2010, the EPA initiated a removal assessment at the Red and Bonita Mine. EPA and the Bureau of Land Management (BLM)/U.S. Department of Agriculture (USDA)-Forest Service are also investigating the viability of removal assessments at the Grand Mogul Mine, which consists of both privately and federally-managed parcels.

3.2 SITE CHARACTERISTICS

3.2.1 Physical Geography

The Cement Creek drainage of the Upper Animas Mining District site is located north of the Town of Silverton, Colorado and is located on a combination of public and private property. The elevation of the Cement Creek drainage ranges from 9,305 to 13,000 feet above MSL (USGS 1955).

3.2.2 Geology

The Cement Creek basin is located in the volcanic terrain of the San Juan Mountains. The area was a late Oligocene volcanic center where the eruption of many cubic miles of lava and volcanic tuffs covered the area to a depth of more than a mile (USGS 1969). The formation of the 10-mile diameter Silverton caldera produced faults that are generally concentric circular features. The caldera collapse was followed by multiple episodes of hydrothermal activity that produced widespread alteration and mineralization of the rocks (USGS 2007a). Cement Creek flows through the middle of the old Silverton caldera (EPA 1999).

The predominant rock type found in the Cement Creek Basin is the Oligocene Age Silverton Volcanics. The Silverton Volcanics are lava flows of intermediate to silicic composition and related volcanoclastic sediments that accumulated to a thickness of approximately 1,000 feet around older volcanoes prior to the subsidence of the Silverton Caldera (USGS 2002).

The regional propylitization of the rocks in the area prior to the collapse of the calderas created an altered regional rock type that contains significant amounts of calcite (CaCO_3), epidote ($\text{Ca}_2\text{Fe}(\text{Al}_2\text{O})(\text{OH})(\text{Si}_2\text{O}_7)(\text{SiO}_4)$), and chlorite ($(\text{MgFeAl})_6(\text{SiAl})_4\text{O}_{10}(\text{OH})_8$), all of which contribute to the intrinsic acid-neutralizing capacity of the major regional rock type. Three major areas of post-caldera collapse mineralization and alteration have been identified in the Cement Creek drainage. The Ohio Peak-Anvil Mountain (OPAM) area on the west side of the lower Cement Creek drainage and the Red Mountains area on the northwest side of the upper Cement Creek drainage are both sites of 23-million-year-old acid-sulfate mineralization. The Eureka Graben area on the upper northeast side of the Cement Creek drainage is the site of 10- to 18-million-year-old emplacement of northeast-trending polymetallic veins of silver, lead, zinc, copper, and often gold that formed as fracture or fissure filling material (USGS 2007d).

The Red Mountain and OPAM acid-sulfate hydrothermal systems cover 22 square kilometers and 21 square kilometers, respectively, along the margin of the collapsed Silverton Caldera on the west and northwest side of the Cement Creek Drainage (Figure 2). Most of the mineralization and mining activity in these two areas has occurred in the Red Mountain area with mines and adits related to the Red Mountain acid-sulfate system found in Prospect, Dry, Georgia, and Corkscrew Gulches, all tributaries of Cement Creek. The ores from these mines commonly contain enargite (Cu_3AsS_4), galena (PbS), chalcocite (Cu_2S), tetrahedrite ($(\text{Cu},\text{Fe})_{12}(\text{Sb},\text{As})_4\text{S}_{13}$), stromeryite (AgCuS), bornite (Cu_5FeS_4), chalcopyrite (CuFeS_2), and pyrite (FeS_2) along with elemental arsenic (As), copper (Cu), lead (Pb), and iron (Fe) (USGS 2007d).

Mineralization in the veins of the Eureka Graben area that is drained by upper Cement Creek include massive pyrite and milky quartz ($\text{FeS}_2\text{—SiO}_2$), chalcopyrite (CuFeS_2), galena (PbS), sphalerite (ZnS), fluorite (CaF_2), and elemental gold (Au) and silver (Ag) (USGS 2007d).

The San Juan Mountains were nearly covered by alpine glaciers during the latest Pleistocene Pinedale glaciation. The thickness of glacial ice is estimated to have ranged from approximately 1,400 feet thick at Gladstone to 1,700 feet thick at Silverton. The Pinedale glaciation ended approximately 12,000 years ago and, except for the glacial till deposits, all surface sediments along Cement Creek were likely deposited after that time (USGS 2007e). Recent human activities have had relatively little influence on the overall shape and physical processes of Cement Creek (USGS 2007e).

3.2.3 Hydrogeology

Approximately 6,000 years ago, Cement Creek cut into the creek bed sediments by as much as 16 feet, causing a drop in the valley bottom shallow water table aquifer. Beginning about A.D. 400, Cement Creek aggraded the stream bed by as much as 10 feet, then between A.D. 1300 and A.D. 1700, Cement Creek cut back to the previous level established approximately 6,000 years ago. These changes in the shallow water table elevations in the valley caused mineralization and cementation of the sediments in the stream course (USGS 2007e).

Groundwater in the Cement Creek area is found in cracks and fissures in the near surface of the igneous rocks that comprise the majority of the area.

3.2.4 Hydrology

The drainage area of Cement Creek is 20.1 square miles (USGS 2007b). Cement Creek flows through the middle of the old caldera, with the period of high flow being May, June, and July in response to snowmelt in the San Juan Mountains, and the periods of low flow occurring in later winter and late summer (EPA 1999). The average flow measured by the USGS on Cement Creek at Silverton before the confluence with the Animas River at station number 09358550 (also known as CC48) between 1992 and 2008 (excluding 1994) was 38.3 cubic feet per second (cfs). The highest average flow on Cement Creek was 56.3 cfs during 1995 and the lowest was 17 cfs during the drought of 2002 (USGS 2009). The drainage area of the Animas River is 146 square miles (USGS 2007b). The average flow measured by the USGS on the Animas River below Silverton at station number 09359020 (also known as A72) between 1992 and 2008 was 281 cfs (USGS 2009).

3.2.5 Meteorology

The Upper Animas River Basin and Cement Creek are located in an alpine climate zone. The average annual precipitation in the area is about 40 inches (National Oceanic and Atmospheric Administration [NOAA] 1973). Winter snowfall is heavy, and severe rain storms occur in the summer (USGS 1969). The average total precipitation for Silverton, Colorado as totaled from the Western Regional Climate Center database is 24.50 inches. The 2-year, 24-hour rainfall event for this area is 2 inches (NOAA 1973).

3.3 PREVIOUS INVESTIGATIONS

- March 1995 *Reconnaissance Feasibility Investigation Report of the Upper Animas River Basin.* Colorado Division of Minerals and Geology. J. Herron, B. Stover, P. Krabacher, and D. Bucknam.
- October 1995 *Animas Discovery Report – Upper Animas River Basin.* CDPHE – Hazardous Materials and Waste Management Division. Camille Farrell.
- February 1997 *Water Quality and Sources of Metal Loading to the Upper Animas River Basin.* CDPHE – Water Quality Control Division. J. Robert Owen.
- July 1997 *Sampling and Analysis Plan for a Site Inspection of the Upper Animas Watershed, Silverton Mining District, San Juan County, Colorado.* CDPHE – Hazardous Materials and Waste Management Division. Camille Farrell.
- April 1998 *Analytical Results Report, Cement Creek Watershed, San Juan County, Colorado.* CDPHE Hazardous Materials and Waste Management Division. Camille Farrell. Five ground water, 6 surface water, 53 sediment, and 15 source samples collected in 1996. Data validation reports are not available. These data are not usable for a HRS evaluation of the site because sample locations are not documented and data validation cannot be documented.
- September 1998 *Cement Creek Reclamation Feasibility Report, Upper Animas River Basin.* Colorado Division of Minerals and Geology. Jim Herron, Bruce Stover, and Paul Krabacher. Forty waste rock locations and

four soil locations in the Cement Creek drainage were sampled by collecting a liquid extract of the rock or soil material from 10 to 20 aliquots at each location. These data are not usable for a HRS evaluation of the site because the analytical results are for extracts from composite samples.

- March 1999 *Site Inspection Analytical Results Report for the Upper Animas Watershed, San Juan County, Colorado.* CDPHE – Hazardous Materials and Waste Management Division. Camille Farrell. Samples of mine waste rock, seeps, surface water, and sediment collected in 1997. Exact locations of samples were not documented. Photographs of sample locations are available. Data validation reports are not available. These data are not usable for an HRS evaluation of the site because sample locations are not documented and data validation cannot be documented.
- May 2009 *Routine Water Quality Sampling, EPA Region 8 Laboratory.* On a monthly basis from May 2009 until the present, EPA personnel have conducted sampling activities at select locations in the Animas River, Cement Creek, and Cement Creek tributaries. At each location EPA personnel collected field data and samples for cations, anions, acidity, total dissolved solids (TDS), total suspended solids (TSS), and total and dissolved metals. Data has been published into a SCRIBE database and in summary spreadsheets made available to the ARSG.

4.0 SOURCES (WASTE CHARACTERISTICS)

There are eight sources of potential contamination identified at the Upper Animas Mining District site, all of which are aqueous or soil sources.

The first source area consists of the waste rock piles and mine discharge at Grand Mogul Mine. The waste rock piles near the portal of the mine are uncovered and easily accessible via the adjacent county road. The waste rock at Grand Mogul Mine consists of three waste rock piles with a total volume of 26,520 cubic yards (UOS 2011c). Water that is exposed to the waste piles flows into Cement Creek. Grand Mogul mine has a collapsed adit, which has had flow rates recorded between 0.004 cubic feet per second

(cfs) in September 2009 and 0.157 cfs in June 2009 (EPA 2011). Metals concentrations observed in the mine discharge (UASW059, Table 2) include 105 micrograms per liter ($\mu\text{g/L}$) for cadmium, 4,690 $\mu\text{g/L}$ for copper, 33.8 $\mu\text{g/L}$ for lead, and 24,900 $\mu\text{g/L}$ for zinc.

The second source area consists of the waste rock piles and adit discharge from Mogul Mine. The waste rock piles are uncovered and easily accessible via the adjacent county road. The waste rock at Mogul Mine consists of one waste rock pile with a volume of 41,374 cubic yards (UOS 2011c). The adit discharge from Mogul Mine passes through a wetland area, where it enters Cement Creek. Mogul Mine has a flumed adit, which has had flow rates recorded between 0.095 cfs in July 2010 and 0.178 cfs in July 2009 (EPA 2011). Metals concentrations observed in the mine discharge (UAAD004, Table 5) include 55 $\mu\text{g/L}$ for cadmium, 15.3 $\mu\text{g/L}$ for copper, 271 $\mu\text{g/L}$ for lead, and 31,300 $\mu\text{g/L}$ for zinc.

The third source area consists of the waste rock piles and adit discharge from the Red and Bonita Mine. The waste rock piles are uncovered and easily accessible via the adjacent county road. The waste rock at Red and Bonita Mine consists of two waste rock piles with a total volume of 3,962 cubic yards (UOS 2011b). The adit discharge from the Red and Bonita Mine flows over waste rock piles, where it is channeled through an iron bog and into Cement Creek. Red and Bonita Mine has a collapsed adit, which has had flow rates recorded between 0.403 cfs in April 2010 and 0.749 cfs in May 2009 (EPA 2011). Metals concentrations observed in the mine discharge (UAAD003, Table 5) include 53.1 $\mu\text{g/L}$ for cadmium, 107 $\mu\text{g/L}$ for lead, and 15,500 $\mu\text{g/L}$ for zinc.

The fourth source area consists of the waste rock piles and adit discharge from the Gold King 7 Level Mine. The waste rock piles are uncovered and easily accessible via the adjacent county road. The waste rock piles were not sampled as a part of this investigation. The adit discharge from the Gold King 7 Level Mine is channeled through a culvert system and flows into the North Fork of Cement Creek. The North Fork of Cement Creek joins with the main stem of Cement Creek downstream of Red and Bonita Mine. Mogul mine has a flumed adit, which has had flow rates recorded between 0.333 cfs in April 2010 and 0.558 cfs in June 2010 (EPA 2011). Metals concentrations observed in the mine discharge (UAAD002, Table 5) include 54.9 $\mu\text{g/L}$ for cadmium, 4,030 $\mu\text{g/L}$ for copper, 6.82 $\mu\text{g/L}$ for lead, and 18,700 $\mu\text{g/L}$ for zinc.

In October of 2010, START collected samples from each of the potential sources and sent them to a CLP lab or the Region 8 EAST lab for metals analysis. The source soil samples and source aqueous samples contained all of the TAL metals in varying amounts. Several metals that potentially may affect targets

along the pathways are cadmium, lead, manganese, and zinc. See the analytical results in Section 11.0 of this report for concentration ranges for each metal.

5.0 GROUNDWATER PATHWAY

The Town of Silverton does not have a municipal intake on Cement Creek or the Animas River, but obtains its drinking water supply from Bear and Boulder Creeks. Bear Creek is located in unmineralized terrain of the Mineral Creek drainage west-southwest of Silverton between Bear and Sultan Mountains. Boulder Creek flows into the Animas River northeast of Silverton after it passes around the Mayflower Tailings Ponds via a diversion (USGS 1955, Town of Silverton 2009). The Town of Silverton does not utilize groundwater (Town of Silverton 2009).

A review of the groundwater well records for wells in the Cement Creek drainage maintained by the State of Colorado Division of Water Resources identified seven domestic or household use wells. At this time, it is not known if the wells in the Cement Creek drainage are used for obtaining drinking water and therefore, START personnel did not investigate the groundwater pathway as part of this investigation.

6.0 SURFACE WATER PATHWAY

The Surface Water Pathway is the pathway most impacted by mining and milling activities in the Cement Creek drainage. Millions of tons of mine and mill waste were dumped directly into the area streams as a normal operating practice between 1890 and 1935 and to a far lesser extent until 1991 (USGS 2007c). The fine-grained material has had ample opportunity to spread downstream and contaminate stream sediment in the Animas River.

The sources of impact to surface water in the Cement Creek drainage are adit discharges and flow over waste piles. The main inflows contributing to surface water contamination are the Grand Mogul Mine, Mogul Mine, Red and Bonita Mine, and Gold King 7 Level Mine. The probable point of entry (PPE) at each of these locations is the point where surface water flow enters Cement Creek either in the form of adit discharge or surface water flow over mine waste.

There are no surface water intakes along the Animas River within the 15-mile downstream limit for drinking water, agricultural, or industrial use, and the first use of surface water below the confluence of Cement Creek with the Animas River is the Tall Timber Ditch Alternative Point 17 miles downstream. The ditch has historically been used for irrigation and is owned by Beggrow Enterprises of Durango, Colorado (Colorado Division of Water Resources 2009). The Animas River is used for occasional sport

recreational use (e.g., rafting) within the 15-mile downstream limit, but the relative inaccessibility of the river along much of the stream course mitigates against active recreational use along the entire stretch (Mild to Wild Rafting 2009). Drinking water for the town of Silverton is taken from Bear Creek in the Mineral Creek drainage and from Boulder Creek in the Animas River drainage outside the area of influence of Cement Creek (Town of Silverton 2009).

Cement Creek itself does not harbor any aquatic life; however, the Animas River below Silverton is stocked and fished (Colorado Division of Wildlife 2009). Rainbow, brook, and native trout are caught in the Animas River below Silverton and consumed by humans (Outdoor World 2009). Elk Park, located approximately 5 miles downstream of Silverton on the Animas River and accessible only by foot, was specifically identified as a location where fishermen catch and consume fish (Outdoor World 2009).

Approximately 2,500 feet of streamside wetlands are found along Cement Creek (U.S. Department of the Interior, Fish and Wildlife Service [USDOI] 1998a, c). Iron bogs are found along the middle stretch of Cement Creek. Approximately 3 miles of palustrine and riverine streamside wetlands are found along the 15-mile downstream segment of the Animas River below the PPE of Cement Creek with the Animas River (USDOI 1998b, d).

START personnel collected surface water samples from Cement Creek, adit discharges, and the Animas River in October of 2010. Background sample UASW030 was collected from Cement Creek upstream of Grand Mogul Mine. Surface water samples indicated that cadmium, copper, lead, manganese, and zinc were at least 3 times the background level. See analytical results in Section 11.0, as well as Table 2 and Figure 6 in this report, for the concentrations of each metal.

7.0 SOIL EXPOSURE

The Upper Animas Mining District has several sources of mine waste. The sources examined as a part of this investigation included soil from the vicinity of the American Tunnel, the Red and Bonita Mine, Mogul Mine, Grand Mogul Mine, Mogul North Mine, and the Grand Mogul Stope. A soil sample could not be collected from the Gold King 7 Level Mine due to sampling limits in the access agreement with the property owner. The mine sites have very little vegetation and no containment, and mine tailings and waste rock remain exposed to the elements. Access to the mine sites is not restricted in any way. The adjacent roads are used for recreation by ATVs and driven on by hunters and tourists in the area. There are no residents or workers on the mine sites and it is unknown if any people reside in the vicinity of the mine sites.

In October 2010, START collected soil samples from waste rock piles in the Upper Animas Mining District Site.

The lynx, which has been observed in the area, is a federally listed threatened and state-listed endangered species, and the Boreal toad is a state-listed endangered species (Colorado Division of Wildlife 2010). The Boreal toad could live in wetlands adjacent to the stream (Colorado Department of Wildlife 2010).

8.0 AIR PATHWAY

The air pathway was not evaluated as a part of this site reassessment because of the reportedly very low population density in the Cement Creek drainage and the fact that the ground surface is snow covered for at least 6 months out of the year.

9.0 DATA QUALITY OBJECTIVES FOR SAMPLING

The EPA Data Quality Objectives (DQO) Process is a seven-step systematic planning approach to develop acceptance or performance criteria for EPA-funded projects. The seven steps of the DQO process are:

- Step 1 The Problem Statement;
- Step 2 Identifying the Decision;
- Step 3 Identifying the Decision Inputs;
- Step 4 Defining the Study Boundaries;
- Step 5 Developing a Decision Rule;
- Step 6 Defining Tolerance Limits on Decision Errors; and
- Step 7 Optimizing the Sample Design.

These DQOs were developed by UOS based on information provided by the TDD and the EPA “Guidance for the Data Quality Objectives Process” (EPA 2000).

Based upon the risks associated with the hazardous substances, the project team identified surface water and soil exposure as the pathways of potential concern at the Upper Animas Mining District site during the September 2010 reconnaissance and the October 2010 sampling activities.

TABLE A
Data Quality Objectives Seven-Step Planning Approach

Step 1 Problem Statement	Step 2 Identifying the Decisions	Step 3 Decision Inputs	Step 4 Study Boundaries	Step 5 Decisions Rules	Step 6 Tolerance Limits on Errors	Step 7 Optimization of Sample Design
The question to be resolved by this SR is whether any contamination from the sources of mine waste in upper Cement Creek have migrated into the environment where it is impacting environmental and/or human health targets. The sources from the upper Cement Creek mine sites may affect the surface water in Cement Creek and the Animas River. Mining-impacted surface water from Cement Creek sources may impact Cement Creek and Animas River wetlands. Impacts to water quality from Cement Creek sources may be impacting Animas River fisheries.	<p>Historic information about the upper Cement Creek mine sites suggests a concern for the likelihood of release of heavy metal contamination and the potential for release of PCBs into Cement Creek and the Animas River. The primary goal for this SR is to determine the presence and extent of surface water and sediment contamination and, if contamination is found, determine if it is attributable to the upper Cement Creek mine sites, and to what degree.</p> <p>The primary study questions for this investigation are:</p> <ul style="list-style-type: none">Do Cement Creek mine waste piles and draining adits contain elevated concentrations of metals?Are the nearby surface waters and associated sediment (i.e., Cement Creek and the Animas River) impacted by the sources?Do sample concentrations exceed applicable benchmarks?If elevated metals and PCBs are identified, are the elevated constituents attributable to Cement Creek sources?	<p>There are two media at the upper Cement Creek drainage, surface water and sediment, which may contain contamination that may pose a risk to the environment or human health. The potential source locations include waste rock/tailings piles, the discharge from the adits of the upper Cement Creek mines, and surface water flow from the waste piles. Waste rock piles (soil) are another potential source, and while low population density exists in the area, the soil may be impacting wetlands. Samples will be analyzed for TAL metals. In addition to metals contamination, the potential exists for PCB contamination at the mines due to equipment use. Selected source and sediment samples will be analyzed for PCBs in addition to metals.</p> <p>The following data will be used to guide decision-making at the site:</p> <ul style="list-style-type: none">Field data and documented observations from surface water, sediment, surface soil (source), and mine drainage (aqueous source) sampling;Analytical data from surface water, sediment, surface soil (source), and mine drainage (aqueous source) samples to determine if contaminants from the upper Cement Creek mine sites have migrated;Identification and documentation of environmental and human health targets potentially impacted by migration of contaminants from the upper Cement Creek mine sites into surface water and sediment; andComparison of analytical results to Maximum Contaminant Levels (MCLs), EPA Regional Screening Levels (RSLs), applicable Superfund Chemical Data Matrix (SCDM) benchmarks, and background levels.	<p>The pathway of concern at the Upper Animas Mining District site is the Surface Water Pathway in Cement Creek and the Animas River. The soil pathway may be a concern, but is not considered to have high exposure due to low population density.</p> <p>Potential human health and environmental targets of the Upper Animas Mining District site include the wetlands and aquatic environments downstream of the upper Cement Creek Mine sites.</p> <p>Samples to be collected and analyzed include surface water and sediment from Cement Creek, the Animas River, and Mineral Creek. In addition, samples were collected from the adits of the Gold King 7 Level Mine, Red and Bonita Mine, Mogul Mine, Grand Mogul Mine, and the American Tunnel. Soil (source) samples were collected from the Red and Bonita Mine, Mogul Mine, North Mogul Mine, Mogul Stope Complex, and Grand Mogul Mine.</p> <p>Field activities were conducted in October and November 2010.</p>	<p>The potential receptors at the Upper Animas Mining District site include aquatic habitats and wetlands. Analytical results for surface water will be compared to Colorado Water Standards and appropriate background samples. Analytical results for sediment will be compared to background sediment results. No benchmarks are established for sediment.</p> <p>Note that some ESAT detection limits are higher than SCDM, Risk-Based Screening Levels (RBSLs), and/or Soil Screening levels (SSLs) for some substances.</p> <p>If contaminants are detected at the Upper Animas Mining District site at levels below 3 times background for those contaminants, then no removal or remediation needs to be done. If contaminants are present at the property at levels equal to or greater than 3 times background, further evaluation may be needed to further characterize the extent of the contamination.</p>	<p>Background sediment and surface water conditions will be determined.</p> <p>Statistical sampling will not be performed; therefore, tolerance limits will not be calculated.</p> <p>Soil (source) samples will be collected to identify potential contaminants and characterize potential areas of contamination.</p> <p>Surface water and sediment samples will be collected to determine the mine impact on surface water.</p> <p>UOS TSOPs will be followed, and any deviations from the FSP will be documented.</p> <p>Issues requiring corrective actions, if needed, will be documented and reported to the EPA Site Assessment Manager.</p> <p>All data will be reviewed, verified, and validated to ensure that they are acceptable for the intended use.</p>	<p>Sample locations have been selected based upon an understanding of known environmental conditions and required information. The following activities will be performed on site to determine if sample locations must be adjusted and how to proceed with sampling:</p> <ul style="list-style-type: none">Collect surface water and sediment samples to determine the extent of metals in Cement Creek and the Animas River and collect samples appropriately to provide information as to attribution from specific mines or gulches;Progress from farthest downstream sample location to prevent cross-contamination;Perform biased grab sampling in accordance with the TSOPs and site assessment protocols;Identify potential human health and sensitive area targets for the Surface Water Pathway; andCollect soil (source) samples to characterize waste materials present in mine dumps. <p>Criteria for data quality parameters are presented in Section 12.0.</p> <p>Data followed the regional Instructions for Interim Emergency Response Electronic Data Deliverable and will include the recommended data elements.</p>

10.0 FIELD PROCEDURES

10.1 SAMPLE LOCATIONS

This SR involved the collection of 116 field samples and 6 field QC/QA samples (Figures 3, 4, and 5). These samples included 47 surface water samples, 47 sediment samples, 14 source soil samples, 4 adit water (aqueous source) samples, and 4 adit sediment samples. Additional QA/QC samples included three duplicate surface water samples and three duplicate sediment samples.

Sample identification followed the following format:

- UA (Matrix ID) (Sample Location)

UA stands for Upper Animas Mining District Site. Matrices were identified as follows:

- SE = sediment
- SW = surface water
- SO = soil

Sample locations were then numbered sequentially. Detailed information about the sample nomenclature is in the approved FSP (UOS 2010).

10.1.1 Surface Water Samples

Forty-three surface water samples plus three surface water duplicate samples were collected. Surface water samples were collected at points on the Animas River, Cement Creek, and Cement Creek tributaries. Figure 3 shows surface water sample locations.

10.1.2 Sediment Samples

Forty-three sediment samples plus three sediment duplicate samples were collected. Sediment samples were co-located with surface water samples, which were collected at points on the Animas River, Cement Creek, and Cement Creek tributaries. Figure 4 shows sediment sample locations.

10.1.3 Source Samples

Soil Source Samples

Fourteen source soil samples were collected. Samples UASO01 and UASO02 were collected in the vicinity of the American Tunnel. Samples UASO03, UASO04, and UASO05 were collected at the Red and Bonita Mine waste piles. Sample UASO06 was collected at the Mogul North Mine waste pile. Samples UASO07 and UASO08 were collected at the Grand Mogul Stope waste piles. Samples UASO09, UASO10, and UASO11 were collected at the Grand Mogul Mine waste piles. Samples UASO12, UASO13, and UASO14 were collected at the Mogul Mine waste piles. Figure 5 shows the source soil sample locations.

Aqueous Source Samples

Four aqueous source samples were collected as part of this investigation. Aqueous source samples were collected at adit discharge points at the Mogul Mine, Red and Bonita Mine, Gold King 7 Level Mine, and the American Tunnel. Figure 4 shows surface water sample locations, including aqueous source sample locations.

Adit Sediment Source Samples

Four adit sediment source samples were collected as part of this investigation. Adit sediment source samples were collected at adit discharge points at the Mogul Mine, Red and Bonita Mine, Gold King 7 Level Mine, and the American Tunnel. Figure 3 shows sediment sample locations, including adit sediment source sample locations.

10.2 SAMPLING METHODS

10.2.1 Surface Water Sampling

Surface water sampling was conducted according to UOS TSOP 4.18, “Surface Water Sampling.” START personnel measured field parameters, including pH, temperature, and electrical conductivity of each sample, as described in TSOP 4.14, “Water Sample Field Measurements” and Table 6 (UOS 2005b). Field instrumentation was calibrated daily and all calibration and field data were recorded in the field logbook. All surface water samples were collected for dissolved metals. Water was drawn through a 2 micrometer

(µm) filter using a peristaltic pump with disposable dedicated Tygon tubing. The water samples were preserved with nitric acid to a pH <2 and stored on ice. Sampling was conducted from the farthest downstream location to the farthest upstream location to minimize the potential for cross-contamination. All surface water sample locations were photographed and documented in the project logbook during sampling activities (UOS 2010). Surface water sample locations which were found to be dry were photographed and documented in the project logbook.

During surface water sampling, START personnel planned to assess wetlands to determine if they meet the 40 CFR 230.3 Definition of a Wetland, but the snow cover on the ground was too extensive to observe wetlands (OFR 2005).

10.2.2 Sediment Sampling

Sediment samples from both streams and adits were collected for total metals and PCB analysis. Sediment sampling was conducted according to UOS TSOP 4.17, “Sediment Sampling” (UOS 2005b). Sediment sampling locations correspond to surface water sampling locations (Figures 3 and 4) (Table 1). START personnel collected sediment samples in conjunction with surface water sampling, and collected the sediment sample after the surface water sample had been collected, proceeding from the most downstream location to the most upstream location. START personnel collected sediment samples using a disposable plastic scoop and a sample jar. Samples for total metals were placed in 8-ounce polypropylene jars, and samples for PCB analysis were placed in 8-ounce amber glass jars. Sediment samples were stored on ice. All sediment sample locations were photographed and documented during sample activities (UOS 2010). At locations UASE012, UASE030, and UASE059 there was not enough sediment to collect samples for PCBs, so only metal samples were collected.

10.2.3 Source Soil Sampling

All 14 of the soil samples collected during the SR were source samples and were collected in accordance with procedures described in UOS TSOP 4.16, “Surface and Shallow Depth Soil Sampling” (UOS 2005b). START personnel dug below snow in several locations on each pile and performed XRF analysis of the driest soil in the hole. In-situ XRF analysis showed waste piles were homogeneous, so START personnel

collected one grab sample from each distinct area of a waste are; for example, one sample per pile, or one sample on each side of large piles. START personnel used disposable plastic scoops for source sample collection. All source samples were collected as biased grab samples from the 6- to 12-inch depth interval, where possible. In the locations in the vicinity of the American Tunnel (UASO01 and UASO02), the ground was too hard to get to the 6-inch depth, and the samples were dug to a depth immediately below the oxidized layer of source material, approximately 2 inches. A pick axe was used to reach the depth needed for the sample and was decontaminated between samples. Sample descriptions were logged in the field logbook. Global Positioning System (GPS) data were collected for each sample location.

10.2.4 Adit Water Sampling

Adit water sampling was conducted according to UOS TSOP 4.18, “Surface Water Sampling.” START personnel measured field parameters, including pH, temperature, and electrical conductivity of each sample, as described in TSOP 4.14, “Water Sample Field Measurements” and Table 6 (UOS 2005b). Field instrumentation was calibrated daily, and all calibration and field data were recorded in the field logbook. All adit water samples were collected for total and dissolved TAL metals. Dissolved metal water samples were drawn through a 2 µm filter using a peristaltic pump with disposable dedicated Tygon tubing. Total metal samples were collected by immersing the sample bottles directly in the sample media. The water samples were preserved with nitric acid to a pH <2 and stored on ice. All adit water sample locations were photographed and documented in the project logbook during sampling activities.

10.3 ANALYTICAL PARAMETERS

Surface water samples were analyzed for dissolved TAL metals by the EPA Region 8 ESAT Laboratory in Golden, Colorado. Adit water samples were analyzed for dissolved TAL metals by EPA Region 8 ESAT Laboratory located in Golden, Colorado. The standard CLP low water (method SOM01.2) contract quantitation limits are 1 µg/L for lead, 5 µg/L for manganese, 5 µg/L for copper, 1 µg/L for cadmium, and 10 µg/L for zinc (EPA 2010).

The sediment and source soil samples were analyzed through the CLP for TAL metals and PCBs. The standard CLP (method SOM01.2) contract quantitation limits are 1 milligram per kilogram

(mg/kg) for arsenic, 0.5 mg/kg for cadmium, 1 mg/kg for lead, 1.5 mg/kg for manganese, 1 mg/kg for silver, 6 mg/kg for zinc (EPA 2010).

11.0 ANALYTICAL RESULTS

The sample data collected during this SR were reviewed using the HRS guidelines for analytical interpretation (OFR 1990). As listed in the analytical results in Tables 2 through 6, elevated concentrations of contaminants reported as significantly above background contaminant values are noted by a star (★) and are determined by sample concentrations based on the following:

- If the background analyte concentration is greater than its Sample Quantitation Limit (SQL), and if the release sample analyte concentration is greater than its SQL, 3 times greater than the background, and 5 times greater than the blank concentration.
- If the background analyte concentration is not greater than its SQL and if the release sample analyte concentration is greater than its SQL, greater than the background Contract Required Detection Limit (CRDL), and 5 times greater than the blank analyte concentration.

All of the CLP RAS and Region ESAT laboratory data have been validated. The data validation reports are presented in Appendix B. CLP Form I documents are also presented in Appendix B with the validation reports.

Previous investigations in the Upper Animas Mining District identified the tailings piles and adit discharges as sources of contamination, but did not yield conclusive information regarding possible migration of contaminants into the Groundwater Pathway, Surface Water Pathway, and the Soil Exposure Pathway. This SR was performed to determine if any contamination from the Upper Animas Mining District site has migrated into the environment where it is impacting potential environmental and/or human health targets. Contaminants are present at the property at levels equal to or greater than SCDM Reference Dose Screening Concentrations (RDSC), Cancer Risk Screening Concentrations (CRSC) or MCLs (EPA 2004). Analytical results for surface water were compared to SCDM RDSC, CRSC, and MCL values. Analytical results for sediment were compared to background sediment results only. No benchmarks have been established for sediment. Analytical results for soil were compared to SCDM RDSC, CRSC, and MCL values.

Data gathered as part of this SR concludes that the Surface Water Pathway is affected by the Upper Animas Mining District site.

11.1 SURFACE WATER RESULTS

Concentrations of 10 dissolved metals results in the surface water samples exceed the action limits set forth for this study for the Surface Water Pathway; this report will discuss only those metals with SCDM toxicity values. The action limits include 3 times the concentration at the background sample location UASW030, the SCDM CRSC, the SCDM RDSC, and the SCDM MCL. Surface water samples indicate that aluminum, cadmium, lead, magnesium, manganese, and zinc concentrations were at least 3 times the background levels. Surface water samples indicate that arsenic, cadmium, manganese, and zinc were detected above the SCDM RDSC. Arsenic was detected above the SCDM CRSC. Arsenic, beryllium, cadmium, copper, lead, and thallium were detected above the SCDM MCL.

A total of 24 samples exceed 3 times background concentrations for cadmium. Of those sample locations UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW020, UASW021, UASW023, UASW024, UASW049, UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had cadmium concentrations greater than 3 times the background of 3.09 µg/L at UASW030. Major contributing locations for cadmium were observed from the Grand Mogul Mine, the North Fork of Cement Creek (and the Gold King 7 Level Mine), and Red and Bonita Mine. Cadmium levels in excess of 3 times the background in Cement Creek are not observed in the Animas River. However, the cadmium concentrations in the Animas River downstream of Cement Creek are 3 times greater than cadmium concentrations upstream of Cement Creek.

A total of 36 samples exceed 3 times background concentrations for copper. Of those sample locations UASW002, UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW020, UASW021, UASW023, UASW024, UASW035, UASW036, UASW037, UASW039, UASW041, UASW042, UASW044, UASW046, UASW047, UASW049, UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had copper concentrations greater than 3 times the background of 25.2 µg/L at UASW030. Major contributing locations for copper were observed from the Grand Mogul Mine and the North Fork of Cement Creek (and the Gold King 7 Level Mine). Copper levels in excess of 3 times the background from Cement Creek are not observed in the Animas River. However, the copper concentrations in the Animas River downstream of Cement Creek are 3 times greater than copper concentrations upstream of Cement Creek.

A total of 39 samples exceed 3 times background concentrations for lead. Of those sample locations UASW002, UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW020, UASW021, UASW023, UASW024, UASW035, UASW036, UASW037, UASW039, UASW041, UASW042, UASW044, UASW046, UASW047, UASW049, UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had lead concentrations greater than 3 times the background of 1.86 µg/L at UASW030. Major contributing locations for lead were observed from the Grand Mogul Mine and Red and Bonita Mine. Lead levels in excess of 3 times the background from Cement Creek are observed in the Animas River. In addition, the lead concentrations in the Animas River downstream of Cement Creek are 3 times greater than lead concentrations upstream of Cement Creek.

A total of 43 samples exceed 3 times background concentrations for manganese. Of those sample locations UASW002, UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW021, UASW023, UASW024, UASW035, UASW036, UASW037, UASW039, UASW041, UASW042, UASW044, UASW046, UASW047, UASW049, UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had manganese concentrations greater than 3 times the background of 120 µg/L at UASW030. Major contributing locations for manganese were observed from the Grand Mogul Mine, the Mogul Mine, and Red and Bonita Mine. Manganese levels in excess of 3 times the background from Cement Creek are observed in the Animas River. However, the manganese concentrations in the Animas River downstream of Cement Creek are not 3 times greater than manganese concentrations upstream of Cement Creek.

A total of 36 samples exceed 3 times background concentrations for zinc. Of those sample locations UASW002, UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW020, UASW021, UASW023, UASW024, UASW035, UASW036, UASW037, UASW039, UASW041, UASW042, UASW044, UASW046, UASW047, UASW049, UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had zinc concentrations greater than 3 times the background of 556 µg/L at UASW030. Major contributing locations for zinc were observed from the Grand Mogul Mine and Red and Bonita Mine. Zinc levels in excess of 3 times the background from Cement Creek are observed in the Animas River. In addition, the zinc concentrations in the Animas River

downstream of Cement Creek are 3 times greater than zinc concentrations upstream of Cement Creek.

See Table 2 for the surface water sample results and Figure 6 for locations of samples locations and results.

11.2 SEDIMENT RESULTS

Concentrations of seven metals in the sediment samples exceeded the action limits set forth for this study in the Surface Water Pathway; this report will discuss only those metals with SCDM toxicity values. The action limit for sediment is 3 times the concentration at the background sample, UASE030. Sediment samples indicated that arsenic, beryllium, lead, and silver were at least 3 times the background levels at select locations. Arsenic concentrations were at least 3 times higher than the background concentration (31.5 mg/kg) in two sediment samples, UASE046 (115 mg/kg) and UASE059 (969 mg/kg). Beryllium concentrations were at least 3 times higher than the background concentration (1.4 mg/kg) in one sediment sample, UASE046 (10.3 mg/kg). Lead concentrations were at least 3 times higher than the background concentration (1,480 mg/kg) in one sediment sample, UASE006 (5,720 mg/kg). Silver concentrations were at least 3 times higher than the background concentration (1.2 mg/kg) in 12 sediment samples, UASE001 (4.5 mg/kg), UASE006 (12.1 mg/kg), UASE014 (8.5 mg/kg), UASE015 (3.9 mg/kg), UASE019 (5.1 mg/kg), UASE022 (27.1 mg/kg), UASE023 (11.8 mg/kg), UASE024 (4.0 mg/kg), UASE040 (3.6 mg/kg), UASE046 (4.1 mg/kg), UASE058 (5.0 mg/kg) and UASE059 (13.2 mg/kg).

Sediment samples were also submitted for PBC analysis. No PCBs were detected in sediment samples above method detection limits.

See Table 3 for the sediment sample results and Figure 7 for sample locations and results. Adit sediment samples are discussed separately under Section 11.5.

11.3 SOURCE SOIL RESULTS

The source soil samples contained all of the TAL metals in varying amounts. Aluminum concentration ranged from 665 mg/kg at Grand Mogul Mine to 19,500 mg/kg at Mogul Mine. Antimony concentrations ranged from non-detect in the area of the American Tunnel to 13.5 mg/kg at Mogul North Mine. Arsenic concentrations ranged from 9.1 mg/kg at Red and Bonita to 96.8 mg/kg at Grand Mogul. Cadmium concentrations ranged from non-detect at multiple

locations to 35.4 mg/kg at Red and Bonita. Copper concentrations ranged from 33.1 mg/kg at Grand Mogul Mine to 4,600 mg/kg at Grand Mogul Mine. Lead concentrations ranged from 241 mg/kg at the American Tunnel to 15,500 mg/kg at Grand Mogul Mine. Magnesium concentrations ranged from non-detect at multiple locations to 12,700 mg/kg at Grand Mogul Mine. Manganese concentrations ranged from 122 mg/kg at Grand Mogul Mine to 5,570 mg/kg at Mogul Mine. Nickel concentrations ranged from non-detect at multiple locations to 9.5 mg/kg at Mogul Mine. Silver concentrations ranged from 1.3 mg/kg at the American Tunnel to 113 mg/kg at Grand Mogul Mine. Zinc concentrations ranged from 102 mg/kg at the American Tunnel to 11,300 mg/kg at Red and Bonita Mine. See Table 4 for source sample results and Figure 8 for soil sample locations and results.

Source soil samples were also submitted for PCB analysis. The only detection for PCBs was in UASO010 collected at Grand Mogul Mine. Arochlor 1248 was detected in UASO010 at a concentration of 12 µg/kg.

11.4 AQUEOUS SOURCE RESULTS

Adit water samples contained varying amounts of TAL total and dissolved metals. Antimony, arsenic, selenium, silver, thallium, and vanadium were non-detect for all total and dissolved samples. Observed total cadmium concentrations ranged from 1.97 µg/L at the American Tunnel portal to 55 µg/L at the Mogul Mine adit. Total copper concentrations ranged from non-detect at the American Tunnel portal and the Red and Bonita portal to 4,030 µg/L at the Gold King 7 Level adit. Total lead concentrations ranged from 3.7 µg/L at the American Tunnel to 271 µg/L at the Mogul Mine adit. Total manganese concentrations ranged from 28,000 µg/L at the Gold King 7 Level to 44,000 µg/L at the American Tunnel portal. Total zinc concentrations ranged from 15,500 µg/L at Red and Bonita Mine to 31,300 µg/L at Mogul Mine.

Observed dissolved cadmium concentrations ranged from 2.02 µg/L at the American Tunnel portal to 53 µg/L at the Gold King 7 Level. Dissolved copper concentrations ranged from non-detect at the American Tunnel portal and the Red and Bonita portal to 4,210 µg/L at the Gold King 7 Level adit. Dissolved lead concentrations ranged from 1.12 µg/L at the American Tunnel to 255 µg/L at the Mogul Mine adit. Dissolved manganese concentrations ranged from 27,800 µg/L at the Gold King 7 Level to 41,700 µg/L at the American Tunnel portal. Total zinc concentrations ranged from 15,400 µg/L at Red and Bonita Mine to 32,700 µg/L at Mogul Mine. See Table 5 for adit water sample results.

11.5 ADIT SEDIMENT SOURCE RESULTS

Adit sediment samples contained varying amounts of total metals. Beryllium and cadmium were non-detect for all samples. Observed antimony concentrations ranged from non-detect at multiple locations to 5.6 mg/kg at the Red and Bonita Mine adit. Observed arsenic concentrations ranged from 19.1 mg/kg at the American Tunnel portal to 126 mg/kg at the Red and Bonita Mine adit. Observed chromium concentrations ranged from non-detect at multiple locations to 7.4 mg/kg at the Red and Bonita Mine adit. Copper concentrations ranged from 11 mg/kg at the Gold King 7 Level to 369 mg/kg at the Red and Bonita Mine adit. Lead concentrations ranged from 59.4 mg/kg at the Red and Bonita Mine adit to 1,740 mg/kg at the Gold King 7 Level adit. Manganese concentrations ranged from 107 mg/kg at the Gold King 7 Level to 2,110 at the Mogul Mine adit. Zinc concentrations ranged from 63.3 mg/kg at Red and Bonita to 361 mg/kg at Gold King 7 Level adit. See Table 6 for adit sediment sample results.

12.0 DATA QUALITY ANALYSIS

12.1 DATA QUALITY OBJECTIVES

The EPA DQO Process is a seven-step systematic planning approach to develop acceptance or performance criteria for EPA-funded projects. Based upon the risks associated with the hazardous substances, the project team identified surface water and soil exposure as the pathways of potential concern at the site. Surface water and sediment samples were used to determine if there was a significant release of contaminants in the Surface Water Pathway. Soil samples were collected to determine the potential for contamination in Cement Creek by flow over mine waste.

This SR was prompted by the many concerns surrounding the Upper Animas Mining District site. The principal goal of this study was to determine if contamination from the Upper Animas Mining District has migrated into the environment where it is impacting potential environmental and/or human health targets in the surface water pathway.

Fifty-four surface water samples and 54 sediment samples plus 3 duplicate surface water and sediment samples were collected in October 2010 from the Animas River, Cement Creek, and their tributaries within the study area to try to attribute contamination in Cement Creek and the Animas River to various sources.

Fourteen source soil samples and four aqueous source samples were collected in October 2010 from the potential sources and the mines in the Upper Animas Mining District.

All analytical data have been reviewed and verified to ensure that data is acceptable for the intended use (Appendix B). The Data Quality Objectives for this project have been met and the data collected is of sufficient quality to answer the study questions.

12.2 DATA VALIDATION AND INTERPRETATION

All data analyzed by the CLP RAS laboratories were validated by a third party subcontracted chemist. All data are acceptable for use as qualified in the data validation report. The data validation report, laboratory forms, and SQL calculations are presented in Appendix B.

There were some qualifications applied to each inorganic data package associated with this sampling event. The ESAT Inductively coupled plasma mass spectroscopy ICMPS data package DG-216 had a “U” qualifier applied to all silver and molybdenum results because silver and molybdenum were detected in the prep blanks. A “J+” qualifier was added to all beryllium results because the calibration showed slightly high results for beryllium.

The CLP Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) data package MH35H7 for the sediment samples had a qualifier “U” applied to antimony for 11 samples because antimony was detected in the blank. A “U” qualifier was applied to beryllium results for 14 samples because beryllium was detected in the blank. A “U” qualifier was applied to cadmium results for six samples because cadmium was detected in the blank. A “U” qualifier was applied to chromium results for three samples because chromium was detected in the blank. A “U” qualifier was applied to cobalt results for six samples because cobalt was detected in the blank. A “U” qualifier was applied to magnesium results for eight samples because magnesium was detected in the blank. A “U” qualifier was applied to nickel results for six samples because nickel was detected in the blank. A “U” qualifier was applied to selenium results for 18 samples because selenium was detected in the blank. A “U” qualifier was applied to silver results for one sample because silver was detected in the blank. A “J+” qualifier was applied to beryllium results for five samples because of interference check exceedance and positive interference. The “J-” qualifier was applied to thallium for negative interference on 10 samples. All samples had a “J” or “UJ” applied for copper and lead because the original and duplicate were both greater than 5 times the CRDL, and the Relative Percent Difference (RPD) was greater than 20 percent. All samples had a

“J” or “UJ” applied for antimony and silver because the spike recoveries were outside control limits. All samples had a “J+” applied for barium and copper because no post-digest spike was performed. All samples had a “J+” applied for arsenic because spike recoveries were outside control limits. All samples had a “J” or “UJ” applied for arsenic, beryllium, cadmium, copper, nickel, and zinc because the dilutions were greater than 10 percent, and the result was at least 50 times the MDL.

The CLP ICP-AES data package MH35L0 for the sediment samples had a qualifier “U” applied to antimony for nine samples because antimony was detected in the blank. A “U” qualifier was applied to beryllium results for eight samples because beryllium was detected in the blank. A “U” qualifier was applied to cadmium results for four samples because cadmium was detected in the blank. A “U” qualifier was applied to chromium results for two samples because chromium was detected in the blank. A “U” qualifier was applied to cobalt results for two samples because cobalt was detected in the blank. A “U” qualifier was applied to nickel results for one sample because nickel was detected in the blank. A “U” qualifier was applied to selenium results for 10 samples because selenium was detected in the blank. A “U” qualifier was applied to silver results for two samples because silver was detected in the blank. A “J+” qualifier was applied to beryllium results for two samples because of interference check exceedance and positive interference. Thallium was qualified “J+” for interference check exceedance and positive interference in all samples. A “J+” qualifier was applied to silver results for eight samples because of interference check exceedance and positive interference. All samples had a “J-” or “UJ” applied for selenium and thallium because the post-digestion spike recoveries were outside control limits. All samples had a “J” or “UJ” applied for antimony and silver because the post-digestion spike recoveries were outside control limits. All samples had a “J+” applied for arsenic because spike recoveries were outside control limits. All samples had a “J” applied for arsenic, lead, and zinc because the dilutions were greater than 10 percent.

The CLP ICP-AES data package MH35E5 for the sediment samples had a qualifier “U” applied to antimony for all samples because antimony was detected in the blank. A “U” qualifier was applied to beryllium results for 15 samples because beryllium was detected in the blank. A “U” qualifier was applied to cadmium results for ten samples because cadmium was detected in the blank. A “U” qualifier was applied to chromium results for one sample because chromium was detected in the blank. A “U” qualifier was applied to magnesium results for one sample because magnesium was detected in the blank. A “U” qualifier was applied to silver results for two

samples because silver was detected in the blank. A “U” qualifier was applied to thallium results for 16 samples because thallium was detected in the blank. A “J+” qualifier was applied to beryllium results for five samples because of interference check exceedance and positive interference. A “J+” qualifier was applied to silver results for 18 samples because of interference check exceedance and positive interference. A “J+” qualifier was applied to thallium results for four samples because of interference check exceedance and positive interference. All samples had a “J” or “UJ” applied for barium and zinc because the original and duplicate were both 5 times the CRDL, and the RPD was greater than 20 percent. All samples had a “J” or “UJ” applied for cadmium because the original and duplicate were both 5 times the CRDL, the absolute difference was greater than the CRQL, and post-digestion spike recoveries were outside control limits. All samples had a “J” qualifier applied for copper because the post-digestion spike recoveries were outside control limits. All samples had a “J” qualifier applied for arsenic, beryllium, cadmium, cobalt, copper, and zinc because the dilutions were greater than 10 percent.

The CLP ICP-AES data package MH35G5 for the sediment samples had a qualifier “U” applied to antimony for 18 samples because antimony was detected in the blank. A “U” qualifier was applied to beryllium results for 18 samples because beryllium was detected in the blank. A “U” qualifier was applied to cadmium results for 15 samples because cadmium was detected in the blank. A “U” qualifier was applied to chromium results for one sample because chromium was detected in the blank. A “U” qualifier was applied to cobalt results for five samples because cobalt was detected in the blank. A “U” qualifier was applied to magnesium results for nine samples because magnesium was detected in the blank. A “U” qualifier was applied to nickel results for four samples because nickel was detected in the blank. A “U” qualifier was applied to selenium results for 20 samples because selenium was detected in the blank. A “U” qualifier was applied to silver results for seven samples because silver was detected in the blank. A “U” qualifier was applied to thallium results for 17 samples because thallium was detected in the blank. A “J+” qualifier was applied to beryllium results for two samples because of interference check exceedance and positive interference. A “UJ” qualifier was applied to thallium for all samples due to a potentially false negative detection in the interference check. All samples had a “J-” or “UJ” qualifier applied for selenium and zinc because the post-digestion spike recoveries were outside control limits. All samples had a “J” or “UJ” qualifier applied for antimony and silver because the post-digestion spike recoveries were outside control limits. All samples had a “J” qualifier applied for arsenic, beryllium, cadmium, chromium, copper, manganese, nickel, and zinc because the dilutions were greater than 10 percent.

13.0 MEASUREMENT QUALITY OBJECTIVES

13.1 FIELD QUALITY CONTROL PROCEDURES

All samples were handled and preserved as described in UOS TSOP 4.2, “Sample Containers, Preservation, and Maximum Holding Times.” Calibration of the pH, temperature, and conductivity meters followed instrument manufacturers’ instruction manuals and UOS TSOP 4.14, “Water Sample Field Measurements.” Sample collection progressed from downstream to upstream to prevent cross-contamination (UOS 2005b).

The following samples were collected to evaluate quality assurance at the site in accordance with the “Guidance for Performing Site Inspections under CERCLA,” Interim Final September 1992, the “Region 8 Supplement to Guidance for Performing Site Inspections under CERCLA,” and the UOS Generic QAPP (EPA 1992, 1993; UOS 2005a):

- Three double volume sediment samples and three double volume surface water samples were used for a MS/MSD. (The double volume samples were not labeled as separate samples.) The percent recoveries and relative differences were within QC limits except for analytes noted in Section 7.2.
- Three field surface water duplicates were collected; the duplicate sample was blind to the lab. The percent difference for the water samples was 4.3 percent.
- Three field sediment duplicates were collected; the duplicate sample was blind to the lab. The percent difference for the water samples was 22.5 percent.

The UOS Generic QAPP serves as the primary guide for the integration of QA/QC procedures for the START contract (UOS 2005a).

13.2 DATA QUALITY INDICATORS

Quality attributes are qualitative and quantitative characteristics of the collected data. The principle quality attributes to environmental studies are precision, bias, representativeness, comparability, completeness, and sensitivity. Data quality indicators (DQIs) are specific indicators of quality attributes. The following DQIs were considered during the review of field collection techniques and field QA/QC results, as well as laboratory QA/QC.

13.2.1 Bias

Bias is systematic or persistent distortion of a measurement process that causes errors in one direction. The extent of bias can be determined by an evaluation of laboratory initial calibration/continuing calibration verification, laboratory control spike/laboratory control, interference checks, spike duplicates, blank spike, MS/MSD, method blank, and trip blank.

A review of the ESAT forms for water samples analyzed for metals detected a high bias in the data set DG-216 for beryllium. There was a positive interference for these metals in the interference check samples. These results were qualified as “J+.”

A review of the CLP forms for soil/sediment samples analyzed for metals detected a high bias in the data sets MH35G5, MH35E5, MH35H7, and MH35L0 for beryllium. Silver and thallium results were biased high in data packages MH35E5 and MH35L0. There was a positive interference for these metals in the interference check samples. These results were qualified as “J+.”

Thallium results were biased low in data packages MH35H7 and MH35G5 because there was a negative interference for these metals in the interference check samples, and the results were qualified “J-/UJ.”

13.2.2 Sensitivity

Sensitivity generally refers to the capability of a method or instrument to discriminate between small differences in analyte concentration and is generally discussed as detection limits. Before sampling begins, it is important to compare detection limits and project requirements in order to select a method with the necessary detection limits to meet the project goals. The detection limits are described in the analytical methods.

All detection limits met the CLP requirements; therefore, all sensitivity requirements for the project were met.

13.2.3 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical, or substantially similar, conditions and is expressed as the

relative percent difference (RPD) between the sample pairs. The field duplicate and MS/MSD were used to evaluate precision.

The average RPD was 4.3 percent for the surface water samples and 22.5 percent for sediment samples. RPD results are presented in Table 7.

13.2.4 Representativeness

Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, a process condition, or an environmental condition. Representativeness was achieved by adherence to TSOPs for sampling procedures, field and laboratory QA/QC procedures, appropriateness of sample material collected, analytical method and sample preparation, and achievement of acceptance criteria documented in the FSP for the project. Some deviations from the FSP were documented in the field logbook.

The following deviations from the final FSP, dated October 21, 2010, were made in the field based on assessments made by the UOS project manager:

- Samples UASW038 and UASE038 (Illinois Gulch) were not collected because the confluence of Illinois Gulch and Cement Creek was located on private property for which START did not have an access agreement.
- Samples UASW048 and UASE048 (Elk Tunnel discharge) were not collected because START personnel could not identify any flow from Elk Tunnel.
- Samples UASW051 and UASE051 (Mammoth Tunnel discharge) were not collected because START personnel could not identify any flow from Mammoth Tunnel.
- Samples UASW053 and UASE053 (Cement Creek downstream of Prospect Gulch) were not collected because they were located on private property for which START did not have an access agreement.
- Samples UASW055 and UASE055 (Cement Creek upstream of Prospect Gulch) were not collected because they were located on private property for which START did not have an access agreement.
- Samples UASW057 and UASE057 (Dry Gulch discharge) were not collected because START personnel could not identify any flow from Dry Gulch.

- The planned location for samples UASW011 and UASE011 was below all of the Gold King 7 Level waste piles. These samples were instead collected where runoff from the upper piles crosses the mine access road. The planned location could not be safely accessed at the toe of the lower piles due to an extremely steep slope, loose material, and snow.
- In addition to adit water, sediment samples were collected from adit discharge points, as START determined it would provide additional information.
- Fewer soil samples than planned were collected. START personnel dug below snow in several locations on each pile and performed XRF analysis of the driest soil in the hole. In-situ XRF analysis showed waste piles were more homogeneous than expected, so the number of samples required for characterization was reduced.
- Soil samples collected in the vicinity of the American Tunnel, UASO001 and UASO002, were obtained from 0 to 1 inch below ground surface because the ground was frozen and the planned depth of 6 inches could not be obtained.
- Soil samples were not collected at the Gold King 7 Level Mine because the waste piles for which START had an access agreement could not be accessed due to unsafe conditions, including extremely steep slope, loose waste rock material, and snow.
- A sediment sample for PCB analysis was not collected at UASE059 (at the toe of Grand Mogul Mine) because there was not enough sediment available for both metals and PCB analysis. Metals analysis was deemed more critical to project goals.
- A sediment sample for PCB analysis was not collected at UASE012 (above Gold King 7 Level Mine) because there was not enough sediment available for both metals and PCB analysis. Metals analysis was deemed more critical to project goals.
- A sediment sample for PCB analysis was not collected at UASE030 (Cement Creek upstream of Grand Mogul Mine) because there was not enough sediment available for both metals and PCB analysis. Metals analysis was deemed more critical to project goals.
- Sample AD005 was not collected because there is no adit discharge from Grand Mogul Mine.

- Surface water and sediment samples were not collected at locations 025, 026, 027, 028, and 031 because START was not able to reach the highest elevations due to snowy and potentially unsafe conditions.
- Soil samples were not collected from the Queen Anne Mine, the Adelphin Mine, and the Columbia Mine because START was not able to reach the highest elevations due to snowy and potentially unsafe conditions.

13.2.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system. The percent completeness for this project was 81 percent. Samples were collected in accordance with the FSP, except where snowy and/or hazardous conditions or access restrictions prevented collection of planned samples.

13.2.6 Comparability

Comparability is the qualitative term that expresses the confidence that two data sets can contribute to common interpretation and analysis and is used to describe how well samples within a data set, as well as two independent data sets, are interchangeable. Validated lab data were obtained to ensure comparability to previous sampling events. All samples were sent to a CLP laboratory or the Region 8 ESAT laboratory, and all data were validated (Appendix B).

All samples were collected using the same FSP, TSOPs, and sampling equipment; therefore, all sample data are comparable.

14.0 SUMMARY

The Upper Animas Mining District has a 100-year history of mining and milling in the mountains surrounding Silverton, Colorado. Sources at the site include mine waste rock and mine adit discharge from several mines contributing metals contamination to Cement Creek and the Animas River.

An observed release to the surface water pathway was documented in October 2010. A release of cadmium, manganese, lead, copper, and zinc was documented and observed by START. The copper, cadmium, and lead concentration in surface water samples were all 3 times the surface water background and exceed the MCL. The manganese concentrations in surface water samples were 3 times background

and exceed the RDSC. The zinc concentrations in surface water samples were 3 times background and exceed the RDSC.

The impact of metals from the mining waste and adit discharges was evident by the orange and yellow precipitate found along Cement Creek. The metals may be directly affecting the fisheries in the Animas River and the wetlands along Cement Creek.

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Figure 1 Site Location Map

Figure 2 Site Details Map

Figure 3 Surface Water Sample Locations

Figure 4 Sediment Sample Locations

Figure 5 Soil Sample Locations

Figure 6 Surface Water Results

Figure 7 Sediment Results

Figure 8 Soil Results

TABLE 1
Sample Locations and Rationale

Matrix	Sample #	Region 8 Sample #	Location	Rationale	Notes
Surface Water	UASW001		Animas River downstream of the confluence with Cement Creek	Determine the impact of Cement Creek on the Animas River and the fisheries it supports	
Surface Water	UASW002		Cement Creek immediately upstream of the confluence with the Animas River	Determine contaminant concentrations in Cement Creek immediately upstream of the confluence with Animas River	
Surface Water	UASW003	A68	Animas River upstream of the confluence with Cement Creek	Establish background concentrations in the Animas River	
Surface Water	UASW004		Cement Creek downstream of the confluence with the South Fork of Cement Creek	Determine the impact of the South Fork of Cement Creek on Cement Creek	
Surface Water	UASW005	CC17	South Fork of Cement Creek	Determine contaminant concentrations in South Fork of Cement Creek	Duplicate and MS/MSD
Surface Water	UASW006		Cement Creek downstream of the American Tunnel and upstream of the confluence with the South Fork of Cement Creek	Determine the impact of the American Tunnel discharge on Cement Creek	
Surface Water	UASW007	CC18	Discharge from the American Tunnel immediately above confluence with Cement Creek	Determine contaminant concentrations in the American Tunnel Discharge	
Surface Water	UASW008		Cement Creek upstream of the American Tunnel	Determine contaminant concentrations in Cement Creek upstream of the confluence with the American Tunnel discharge	
Surface Water	UASW009		Cement Creek downstream of the confluence with the North Fork of Cement Creek	Determine the impact of the North Fork of Cement Creek on Cement Creek	
Surface Water	UASW010		North Fork of Cement Creek upstream of the confluence with Cement Creek	Determine contaminant concentrations in the North Fork of Cement Creek	
Surface Water	UASW011		North Fork of Cement Creek downstream of the Gold King 7 Level Mine - at road crossing	Determine the impact of the Gold King 7 Level Mine on Cement Creek	
Surface Water	UASW012		North Fork of Cement Creek upstream of the Gold King 7 Level Mine	Determine background in the North Fork of Cement Creek above Gold King 7 Level	
Surface Water	UASW013		Cement Creek upstream of the confluence with the North Fork of Cement Creek	Determine contaminant concentrations in Cement Creek upstream of the confluence with the North Fork of Cement Creek	
Surface Water	UASW014		Cement Creek downstream of Red and Bonita Mine	Determine the impact of Red and Bonita Mine on Cement Creek	
Surface Water	UASW015	CC03D	Drainage channel adjacent to county road below Red and Bonita	Determine contaminant concentrations at the base of the Red and Bonita piles	
Surface Water	UASW016	OPP12	Cement Creek upstream of Red and Bonita Mine	Determine contaminant concentrations in Cement Creek prior to the addition of Red and Bonita discharge	
Surface Water	UASW017		Cement Creek downstream of wetland that channels Mogul Mine drainage	Determine the impact of Mogul Mine drainage on Cement Creek	
Surface Water	UASW018		Cement Creek upstream of wetland that contains Mogul Mine drainage	Determine contaminant concentrations in Cement Creek upstream of Mogul Mine	
Surface Water	UASW019		Mogul Mine drainage (in wetland)	Determine contaminant concentrations in Mogul Mine drainage	Duplicate and MS/MSD
Surface Water	UASW020		Cement Creek upstream of Mogul Mine	Determine contaminant concentrations in Cement Creek upstream of Mogul Mine drainage	

TABLE 1
Sample Locations and Rationale

Matrix	Sample #	Region 8 Sample #	Location	Rationale	Notes
Surface Water	UASW021		Cement Creek downstream of Mogul North Mine	Determine the impact of Mogul North Mine on Cement Creek	
Surface Water	UASW022	CC02A	Mogul North Mine discharge	Determine contaminant concentrations in Mogul North Mine discharge	
Surface Water	UASW023	CC01T	Cement Creek upstream of Mogul North Mine and downstream of confluence with Lower Ross	Determine contaminant concentrations in Cement Creek tributary upstream of Mogul North Mine	
Surface Water	UASW024	CC01S	Cement Creek downstream of Queen Anne Mine and upstream of confluence with Lower Ross	Determine contaminant concentrations in Cement Creek downstream of Queen Anne Mine and upstream of Mogul Mine	
Surface Water	UASW029	A72	Animas River Below Silverton		
Surface Water	UASW030	CC01F	Lower Ross Basin Drainage upstream of Grand Mogul Mine	Determine contaminant concentrations in Lower Ross Basin Drainage downstream of Adelphin Mine and upstream of Grand Mogul Mine	
Surface Water	UASW032		Animas River downstream of the confluence with Mineral Creek	Determine the impact of Mineral Creek on the Animas River	
Surface Water	UASW033	M34	Mineral Creek upstream of the confluence with the Animas River	Determine contaminant concentrations in Mineral Creek	
Surface Water	UASW034		Animas River upstream of the confluence with Mineral Creek	Determine contaminant concentrations in the Animas River upstream of the confluence with Mineral Creek	
Surface Water	UASW035	CC48	Cement Creek downstream of the Kendrick-Gelder Smelter	Determine the impact of the Kendrick-Gelder smelter on Cement Creek	Duplicate and MS/MSD
Surface Water	UASW036		Cement Creek upstream of the Kendrick-Gelder Smelter	Determine contaminant concentrations in Cement Creek upstream of Kendrick-Gelder Smelter	
Surface Water	UASW037		Cement Creek downstream of the Illinois Gulch drainage	Determine the impact of Illinois Gulch drainage on Cement Creek	
Surface Water	UASW039		Cement Creek upstream of the confluence with Illinois Gulch drainage and downstream of Ohio Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of Illinois Gulch drainage and downstream of Ohio Gulch drainage	
Surface Water	UASW040		Ohio Gulch drainage	Determine contaminant concentrations in Ohio Gulch drainage	
Surface Water	UASW041		Cement Creek upstream of the confluence with Ohio Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of Ohio Gulch drainage	
Surface Water	UASW042		Cement Creek downstream of the Anglo Saxon Mine drainage	Determine the impact of Anglo Saxon Mine drainage on Cement Creek	
Surface Water	UASW043		Anglo Saxon Mine drainage	Determine contaminant concentrations in Anglo Saxon Mine drainage	
Surface Water	UASW044		Cement Creek upstream of the Anglo Saxon Mine and downstream of Minnesota Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of the Anglo Saxon Mine and downstream of Minnesota Gulch drainage	
Surface Water	UASW045		Minnesota Gulch drainage	Determine contaminant concentrations in Minnesota Gulch drainage	
Surface Water	UASW046		Cement Creek upstream of the confluence with Minnesota Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of Minnesota Gulch drainage	

TABLE 1
Sample Locations and Rationale

Matrix	Sample #	Region 8 Sample #	Location	Rationale	Notes
Surface Water	UASW047		Cement Creek downstream of the Elk Tunnel and Fairview Gulch	Determine the impact of the Elk Tunnel and Fairview Gulch on Cement Creek	
Surface Water	UASW049		Cement Creek upstream of the confluence with Fairview Gulch and the Elk Tunnel discharge and downstream of Georgia Gulch	Determine contaminant concentrations in Cement Creek upstream of Fairview Gulch and the Elk Tunnel Discharge and downstream of Georgia Gulch	
Surface Water	UASW050		Cement Creek upstream of Georgia Gulch and downstream of the Mammoth Tunnel	Determine the impact of the Mammoth Tunnel on Cement Creek	
Surface Water	UASW054		Prospect Gulch drainage	Determine contaminant concentrations in Prospect Gulch drainage	
Surface Water	UASW056		Cement Creek downstream of the Dry Gulch drainage	Determine the impact of Dry Gulch drainage on Cement Creek	
Surface Water	UASW058		Cement Creek upstream of the confluence with Dry Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of Dry Gulch drainage	
Surface Water	UASW059		Cement Creek at the toe of Grand Mogul Mine	Determine contaminant contributions in Grand Mogul Mine Drainage	
Surface Water	UAAD001	CC19	American Tunnel discharge (at portal)	Determine contaminant concentrations in American Tunnel Discharge	
Surface Water	UAAD002	CC06	Upper Gold King 7 Level Mine adit discharge	Determine contaminant concentrations in Gold King 7 Level Mine adit Discharge	
Surface Water	UAAD003	CC03C	Red and Bonita Mine adit discharge	Determine contaminant concentrations in Red and Bonita Mine adit Discharge	
Surface Water	UAAD004	CC02D	Mogul Mine adit discharge	Determine contaminant concentrations in Mogul Mine adit Discharge	
Surface Water	UASW097		Duplicate Sample and MS/MSD Sample: Dup of UASW035	MS/MSD is collected to test the precision of laboratory analytical methods. Duplicate is collected to document the precision of sample collection procedures and laboratory analysis.	
Surface Water	UASW098		Duplicate Sample and MS/MSD Sample: Dup of UASW005	MS/MSD is collected to test the precision of laboratory analytical methods. Duplicate is collected to document the precision of sample collection procedures and laboratory analysis.	
Surface Water	UASW099		Duplicate Sample and MS/MSD Sample: Dup of UASW019	MS/MSD is collected to test the precision of laboratory analytical methods. Duplicate is collected to document the precision of sample collection procedures and laboratory analysis.	
Sediment	UASE001		Animas River downstream of the confluence with Cement Creek	Determine the impact of Cement Creek on the Animas River and the fisheries it supports	
Sediment	UASE002		Cement Creek immediately upstream of the confluence with the Animas River	Determine contaminant concentrations in Cement Creek immediately upstream of the confluence with Animas River	
Sediment	UASE003	A68	Animas River upstream of the confluence with Cement Creek	Establish background concentrations in the Animas River	
Sediment	UASE004		Cement Creek downstream of the confluence with the South Fork of Cement Creek	Determine the impact of the South Fork of Cement Creek on Cement Creek	

TABLE 1
Sample Locations and Rationale

Matrix	Sample #	Region 8 Sample #	Location	Rationale	Notes
Sediment	UASE005	CC17	South Fork of Cement Creek	Determine contaminant concentrations in South Fork of Cement Creek	Duplicate and MS/MSD
Sediment	UASE006		Cement Creek downstream of the American Tunnel and upstream of the confluence with the South Fork of Cement Creek	Determine the impact of the American Tunnel discharge on Cement Creek	
Sediment	UASE007	CC18	Discharge from the American Tunnel immediately above confluence with Cement Creek	Determine contaminant concentrations in the American Tunnel Discharge	
Sediment	UASE008		Cement Creek upstream of the American Tunnel	Determine contaminant concentrations in Cement Creek upstream of the confluence with the American Tunnel discharge	
Sediment	UASE009		Cement Creek downstream of the confluence with the North Fork of Cement Creek	Determine the impact of the North Fork of Cement Creek on Cement Creek	
Sediment	UASE010		North Fork of Cement Creek upstream of the confluence with Cement Creek	Determine contaminant concentrations in the North Fork of Cement Creek	
Sediment	UASE011		North Fork of Cement Creek downstream of the Gold King 7 Level Mine - at road crossing	Determine the impact of the Gold King 7 Level Mine on Cement Creek	
Sediment	UASE012		North Fork of Cement Creek upstream of the Gold King 7 Level Mine	Determine background in the North Fork of Cement Creek above Gold King 7 Level	
Sediment	UASE013		Cement Creek upstream of the confluence with the North Fork of Cement Creek	Determine contaminant concentrations in Cement Creek upstream of the confluence with the North Fork of Cement Creek	
Sediment	UASE014		Cement Creek downstream of Red and Bonita Mine	Determine the impact of Red and Bonita Mine on Cement Creek	
Sediment	UASE015	CC03D	Drainage channel adjacent to county road below Red and Bonita	Determine contaminant concentrations at the base of the Red and Bonita piles	
Sediment	UASE016	OPP12	Cement Creek upstream of Red and Bonita Mine	Determine contaminant concentrations in Cement Creek prior to the addition of Red and Bonita discharge	
Sediment	UASE017		Cement Creek downstream of wetland that channels Mogul Mine drainage	Determine the impact of Mogul Mine drainage on Cement Creek	
Sediment	UASE018		Cement Creek upstream of wetland that contains Mogul Mine drainage	Determine contaminant concentrations in Cement Creek upstream of Mogul Mine	
Sediment	UASE019		Mogul Mine drainage (in wetland)	Determine contaminant concentrations in Mogul Mine drainage	Duplicate and MS/MSD
Sediment	UASE020		Cement Creek upstream of Mogul Mine	Determine contaminant concentrations in Cement Creek upstream of Mogul Mine drainage	
Sediment	UASE021		Cement Creek downstream of Mogul North Mine	Determine the impact of Mogul North Mine on Cement Creek	
Sediment	UASE022	CC02A	Mogul North Mine discharge	Determine contaminant concentrations in Mogul North Mine discharge	
Sediment	UASE023	CC01T	Cement Creek upstream of Mogul North Mine and downstream of confluence with Lower Ross	Determine contaminant concentrations in Cement Creek tributary upstream of Mogul North Mine	
Sediment	UASE024	CC01S	Cement Creek downstream of Queen Anne Mine and upstream of confluence with Lower Ross	Determine contaminant concentrations in Cement Creek downstream of Queen Anne Mine and upstream of Mogul Mine	

TABLE 1
Sample Locations and Rationale

Matrix	Sample #	Region 8 Sample #	Location	Rationale	Notes
Sediment	UASE029	A72	Animas River Below Silverton		
Sediment	UASE030	CC01F	Lower Ross Basin Drainage upstream of Grand Mogul Mine	Determine contaminant concentrations in Lower Ross Basin Drainage downstream of Adelphin Mine and upstream of Grand Mogul Mine	
Sediment	UASE032		Animas River downstream of the confluence with Mineral Creek	Determine the impact of Mineral Creek on the Animas River	
Sediment	UASE033	M34	Mineral Creek upstream of the confluence with the Animas River	Determine contaminant concentrations in Mineral Creek	
Sediment	UASE034		Animas River upstream of the confluence with Mineral Creek	Determine contaminant concentrations in the Animas River upstream of the confluence with Mineral Creek	
Sediment	UASE035	CC48	Cement Creek downstream of the Kendrick-Gelder Smelter	Determine the impact of the Kendrick-Gelder smelter on Cement Creek	Duplicate and MS/MSD
Sediment	UASE036		Cement Creek upstream of the Kendrick-Gelder Smelter	Determine contaminant concentrations in Cement Creek upstream of Kendrick-Gelder Smelter	
Sediment	UASE037		Cement Creek downstream of the Illinois Gulch drainage	Determine the impact of Illinois Gulch drainage on Cement Creek	
Sediment	UASE039		Cement Creek upstream of the confluence with Illinois Gulch drainage and downstream of Ohio Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of Illinois Gulch drainage and downstream of Ohio Gulch drainage	
Sediment	UASE040		Ohio Gulch drainage	Determine contaminant concentrations in Ohio Gulch drainage	
Sediment	UASE041		Cement Creek upstream of the confluence with Ohio Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of Ohio Gulch drainage	
Sediment	UASE042		Cement Creek downstream of the Anglo Saxon Mine drainage	Determine the impact of Anglo Saxon Mine drainage on Cement Creek	
Sediment	UASE043		Anglo Saxon Mine drainage	Determine contaminant concentrations in Anglo Saxon Mine drainage	
Sediment	UASE044		Cement Creek upstream of the Anglo Saxon Mine and downstream of Minnesota Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of the Anglo Saxon Mine and downstream of Minnesota Gulch drainage	
Sediment	UASE045		Minnesota Gulch drainage	Determine contaminant concentrations in Minnesota Gulch drainage	
Sediment	UASE046		Cement Creek upstream of the confluence with Minnesota Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of Minnesota Gulch drainage	
Sediment	UASE047		Cement Creek downstream of the Elk Tunnel and Fairview Gulch	Determine the impact of the Elk Tunnel and Fairview Gulch on Cement Creek	
Sediment	UASE049		Cement Creek upstream of the confluence with Fairview Gulch and the Elk Tunnel discharge and downstream of Georgia Gulch	Determine contaminant concentrations in Cement Creek upstream of Fairview Gulch and the Elk Tunnel Discharge and downstream of Georgia Gulch	
Sediment	UASE050		Cement Creek upstream of Georgia Gulch and downstream of the Mammoth Tunnel	Determine the impact of the Mammoth Tunnel on Cement Creek	
Sediment	UASE054		Prospect Gulch drainage	Determine contaminant concentrations in Prospect Gulch drainage	

TABLE 1
Sample Locations and Rationale

Matrix	Sample #	Region 8 Sample #	Location	Rationale	Notes
Sediment	UASE056		Cement Creek downstream of the Dry Gulch drainage	Determine the impact of Dry Gulch drainage on Cement Creek	
Sediment	UASE058		Cement Creek upstream of the confluence with Dry Gulch drainage	Determine contaminant concentrations in Cement Creek upstream of Dry Gulch drainage	
Sediment	UASE059		Cement Creek at the toe of Grand Mogul Mine	Determine contaminant contributions in Grand Mogul Mine Drainage	
Sediment	UASE060		Re-collect of UASE010: North Fork of Cement Creek upstream of the confluence with Cement Creek	Determine contaminant concentrations in the North Fork of Cement Creek	
	UASE097		Duplicate Sample and MS/MSD Sample: Dup of UASE035	MS/MSD is collected to test the precision of laboratory analytical methods. Duplicate is collected to document the precision of sample collection procedures and laboratory analysis.	
	UASE098		Duplicate Sample and MS/MSD Sample: Dup of UASE005	MS/MSD is collected to test the precision of laboratory analytical methods. Duplicate is collected to document the precision of sample collection procedures and laboratory analysis.	
	UASE099		Duplicate Sample and MS/MSD Sample: Dup of UASE019	MS/MSD is collected to test the precision of laboratory analytical methods. Duplicate is collected to document the precision of sample collection procedures and laboratory analysis.	
Soil	UASO001		American Tunnel	Characterize source in vicinity of American Tunnel	
Soil	UASO002		American Tunnel	Characterize source in vicinity of American Tunnel	
Soil	UASO003		Red and Bonita Mine – top pile	Characterize source at Red and Bonita Mine	
Soil	UASO004		Red and Bonita Mine – middle pile	Characterize source at Red and Bonita Mine	
Soil	UASO005		Red and Bonita Mine – bottom pile	Characterize source at Red and Bonita Mine	
Soil	UASO006		Mogul North Mine waste pile	Characterize source at North Mogul Mine	
Soil	UASO007		Grand Mogul stope – west side	Characterize source at Grand Mogul Stope	
Soil	UASO008		Grand Mogul stope – east side	Characterize source at Grand Mogul Stope	
Soil	UASO009		Grand Mogul Mine waste piles – east side	Characterize source at Grand Mogul Mine	
Soil	UASO010		Grand Mogul Mine waste piles – center	Characterize source at Grand Mogul Mine	
Soil	UASO011		Grand Mogul Mine waste piles – west side	Characterize source at Grand Mogul Mine	
Soil	UASO012		Mogul Mine waste piles – west side	Characterize source at Mogul Mine	
Soil	UASO013		Mogul Mine waste piles – adjacent to shed	Characterize source at Mogul Mine	
Soil	UASO014		Mogul Mine waste piles – east side	Characterize source at Mogul Mine	

TABLE 2 Surface Water Results													
Sample ID:				UASW030	UASW001	UASW002	UASW003	UASW004	USSW005	UASW006	UASW007	UASW008	UASW009
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		Lower Ross Basin Drainage upstream of Grand Mogul Mine	Animas River downstream of the confluence with Cement Creek	Cement Creek immediately upstream of the confluence with the Animas River	Animas River upstream of the confluence with Cement Creek	Cement Creek downstream of confluence with the South Fork of Cement Creek	South Fork of Cement Creek	Cement Creek downstream of the American Tunnel and upstream of the confluence with the South Fork of Cement Creek	Discharge from the American Tunnel immediately above confluence with Cement Creek	Cement Creek upstream of the American Tunnel	Cement Creek downstream of the confluence with the North Fork of Cement Creek
	RDSC	CRSC	MCL/MCLG	(Background)									
Analytes	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Aluminum				69	7330 ☆	7810 ☆	86.2	5130 ☆	720 ☆	9160 ☆	5730 ☆	7940 ☆	7030 ☆
Antimony	15		6	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U
Arsenic	11	0.057	10	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U
Barium	2,600		2,000	30.8 JD	25 U	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U
Beryllium	73		4.0	0.5 U	1.17 D	0.826 JD	0.5 U	2.28 D	0.5 U	3.61 D	3.54 D	2.88 D	3.57 D
Cadmium	18		5.0	3.09 D	6.19 D	6.55 D	1.82 D	16.1 D ★	2.73 D	30.3 D ★	2.54 D	28.7 D ★	29.1 D ★
Calcium				46200	169000 ☆	175000☆	54300	202000☆	162000 ☆	258000 ☆	450000 ☆	238000 ☆	230000 ☆
Chromium	110		100	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U
Cobalt				0.5 U	20.4 D	23.7 D	0.5 U	33 D	7.71 D	59.4 D	136 D	46.6 D	49.2 D
Copper			1,300	25.2 D	121 D ☆	148 D ☆	2.5 U	398 D ☆	8.83 D	796 D ☆	5 U	884 D ☆	909 D ☆
Iron				100 U	10800	11500	100 U	16200	3230	32500	131000	30000	31400
Lead			15	0.62 JD	17.8 D ★	17.8 D ★	0.79 JD	25 D ★	0.643 JD	44.8 D ★	1.52 JD	19.3 D ★	14.6 D ☆
Magnesium				4060	10400	10900	3290	13100 ☆	8230	18200 ☆	31400 ☆	16100 ☆	15600 ☆
Manganese	5,100			120	4760 ☆	4650 ☆	1940 ☆	10100 ★	1840 ☆	18500 ★	43000 ★	14800 ★	14800 ★
Molybdenum	11		2.0	0.5 U	0.5 U	1.04 JD	3.63 D	0.5 U	0.535 JD	0.5 U	1 U	0.5 U	0.5 U
Nickel	730			2.5 U	8.46 D	10.6 D	2.5 U	14.7 D	2.5 U	24.8 D	46.9 D	20.8 D	328 D
Potassium				294 J	1700 ☆	1790 ☆	614 J	933 J ☆	747 J	987 J ☆	1740 ☆	926 J ☆	899 J ☆
Selenium	180		50	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U
Silver	180			0.5 U	0.5 U	0.953 JD	0.843 JD	0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U
Sodium				1230	4450 ☆	4540 ☆	4480 ☆	4480 ☆	3470	5630 ☆	9500 ☆	5100 ☆	4820 ☆
Thallium			0.50	2.5 U	2.5 U	5.61 D	15.4 D	2.5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U
Vanadium	260			5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
Zinc	11,000			556	2410 ☆	2370☆	449	5510 ☆	647	10700 ☆	18800 ★	9230 ☆	9350 ☆

Sample ID:				UASW030	UASW010	UASW011	UASW012	UASW013	UASW014	UASW015	UASW016	UASW017	UASW018
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		Lower Ross Basin Drainage upstream of Grand Mogul Mine	North Fork of Cement Creek upstream of the confluence with Cement Creek	North Fork of Cement Creek downstream of the Gold King 7 Level Mine	North Fork of Cement Creek upstream of the Gold King 7 Level Mine	Cement Creek upstream of the confluence with the North Fork of Cement Creek	Cement Creek downstream of Red and Bonita Mine	Drainage channel adjacent to county road below Red and Bonita	Cement Creek upstream of Red and Bonita Mine	Cement Creek downstream of wetland that channels Mogul Mine drainage	Cement Creek upstream of wetland that contains Mogul Mine drainage
	RDSC	CRSC	MCL/MCLG	(Background)									
Analytes	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Aluminum				69	23500 ☆	18100 ☆	3820 ☆	3550 ☆	4980 ☆	3040 ☆	2480 ☆	2570 ☆	2830 ☆
Antimony	15		6	2.5 U	5 U	5 U	2.5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	2.5 U
Arsenic	11	0.057	10	2.5 U	5 U	5 U	2.5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	2.5 U
Barium	2,600		2,000	30.8 JD	50 U	50 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U
Beryllium	73		4.0	0.5 U	6.34 D	7.06 D	0.595 JD	2.73 D	3.03 D	6.95 D	0.5 U	1.08 D	0.76 JD
Cadmium	18		5.0	3.09 D	63.7 D ★	53.3 D ★	4.69 D	22 D ★	25.8 D ★	42.2 D ★	13.7 D ★	15.8 D ★	19.2 D ★
Calcium				46200	348000 ☆	388000	52500	210000	231000	450000	87800	81400	71600
Chromium	110		100	2.5 U	5 U	5 U	2.56 JD	2.5 U	2.5 U	5 U	2.5 U	2.5 U	2.5 U
Cobalt				0.5 U	83.1 D	81.4 D	7.94 D	36.3 D	46 D	95.9 D	1.83 D	2.34 D	3.02 D
Copper			1,300	25.2 D	4230 D ★	4580 D ★	291 D ☆	128 D ☆	121 D ☆	5 U	140 D ☆	201 D ☆	240 D☆
Iron				100 U	52900	66700	100 U	27700	30600	95200	210 J	186 J	413
Lead			15	0.62 JD	5.93 D ☆	5.66 D ☆	4.5 D ☆	13.3 D ☆	16.1 D ★	13.1 D ☆	7.42 D ☆	12.6 D ☆	11.9 D ☆
Magnesium				4060	24800 ☆	22300 ☆	7230	14000 ☆	15700 ☆	28900 ☆	6010	6280	6880
Manganese	5,100			120	23700 ★	26000 ★	742 ☆	12800 ★	14900 ★	31900 ★	3000 ☆	3370 ☆	4040 ☆
Molybdenum	11		2.0	0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U
Nickel	730			2.5 U	39.3 D	35.8 D	5.44 D	16.3 D	20.2 D	38.6 D	3.23 JD	4.23 JD	5.71 D
Potassium				294 J	1430 ☆	1790 ☆	545 J	874 J	920 J ☆	1850 ☆	532 J	568 J	593 J
Selenium	180		50	2.5 U	5 U	5 U	2.5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	2.5 U
Silver	180			0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U
Sodium				1230	5140 ☆	5240 ☆	2040	4980 ☆	5430 ☆	8800 ☆	2890	2610	2190
Thallium			0.50	2.5 U	5 U	5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Vanadium	260			5 U	10 U	10 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
Zinc	11,000			556	16200 ★	17100 ★	924	7890 ☆	8770 ☆	15500 ★	4640 ☆	4910 ☆	5950 ☆

TABLE 2
Surface Water Results

Sample ID:				UASW030	UASW019	UASW020	UASW021	UASW022	UASW023	UASW024	UASW029	UASW032	UASW033
Location:	Superfund Chemical Data Matrix (SCDM) RDSC	Superfund Chemical Data Matrix (SCDM) CRSC	MCL/MCLG	Lower Ross Basin Drainage upstream of Grand Mogul Mine (Background)	Mogul Mine drainage	Cement Creek upstream of Mogul Mine	Cement Creek downstream of Mogul North Mine	Mogul North Mine discharge	Cement Creek upstream of Mogul North Mine	Cement Creek upstream of confluence with Lower Ross Basin Drainage	Animas River Below Silverton	Animas River downstream of the confluence with Mineral Creek	Mineral Creek upstream of the confluence with the Animas River
Analytes	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Aluminum				69	10100 ☆	996 ☆	1520 ☆	1430 ☆	1580 ☆	2180 ☆	1300 ☆	275 ☆	381 ☆
Antimony	15		6	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Arsenic	11	0.057	10	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Barium	2,600		2,000	30.8 JD	25 U	25 U	26.3 JD	39.4 JD	29.1 JD	34.7 JD	25 U	25 U	25 U
Beryllium	73		4.0	0.5 U	3.8 D	0.5 U	0.649 JD	0.5 U	0.5 U	0.968 JD	0.5 U	0.5 U	0.5 U
Cadmium	18		5.0	3.09 D	72.8 D ★	8.88 D ★	12 D ★	10.9 D ★	13.6 D ★	16.9 D ★	0.653 JD	1.76 D	0.926 JD
Calcium				46200	174000	45100	55900	62000	55400	72700	87500	76900	57500
Chromium	110		100	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Cobalt				0.5 U	22.6 D	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3.84 D	0.5 U	3.75 D
Copper			1,300	25.2 D	820 D ☆	91.1 D ☆	105 D ☆	22.3 D	102 D ☆	38.6 D	2.5 U	13.9 D	2.5 U
Iron				100 U	4460	100 U	100 U	100 U	100 U	100 U	8140	2630	2800
Lead			15	0.62 JD	75.6 D ★	4.01 D ☆	2.62 D ☆	2.54 D ☆	2.03 D ☆	2.21 D ☆	8.74 D ☆	0.5 U	1.23 D
Magnesium				4060	13600 ☆	5520	7150	8310	7020	9760	7330	5720	4860
Manganese	5,100			120	21900 ★	306	550 ☆	111	633 ☆	977 ☆	796 ☆	1270 ☆	327
Molybdenum	11		2.0	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Nickel	730			2.5 U	13.6 D	4.42 JD	6.43 D	9.47 D	6.06 D	12.1 D	2.5 U	2.5 U	2.5 U
Potassium				294 J	1420 ☆	462 J	517 J	634 J	250 J	561 J	1620 ☆	856 J	629 J
Selenium	180		50	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Silver	180			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium				1230	5520 ☆	1150	1260	1260	1280	1340	5580 ☆	3570	3300
Thallium			0.50	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Vanadium	260			5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Zinc	11,000			556	27600 ★	1920 ☆	2550 ☆	3080 ☆	2750 ☆	3230 ☆	94.6	558	185

Sample ID:				UASW030	UASW034	UASW035	UASW036	UASW037	UASW039	UASW040	UASW041	UASW042	UASW043
Location:	Superfund Chemical Data Matrix (SCDM) RDSC	Superfund Chemical Data Matrix (SCDM) CRSC	MCL/MCLG	Lower Ross Basin Drainage upstream of Grand Mogul Mine (Background)	Animas River upstream of the confluence with Mineral Creek	Cement Creek downstream of the Kendrick-Gelder Smelter	Cement Creek upstream of the Kendrick-Gelder Smelter	Cement Creek downstream of the Illinois Gulch drainage	Cement Creek upstream of the confluence with Illinois Gulch drainage and downstream of Ohio Gulch drainage	Ohio Gulch drainage	Cement Creek upstream of the confluence with Ohio Gulch drainage	Cement Creek downstream of the Anglo Saxon Mine drainage	Anglo Saxon Mine drainage
Analytes	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Aluminum				69	530 ☆	7890 ☆	7800 ☆	7580 ☆	8320 ☆	17100 ☆	8090 ☆	7870 ☆	225 ☆
Antimony	15		6	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U
Arsenic	11	0.057	10	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U
Barium	2,600		2,000	30.8 JD	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	50 U
Beryllium	73		4.0	0.5 U	0.5 U	1.14 D	0.91 JD	0.986 JD	0.925 JD	1.72 D	1.58 D	1.36 D	1.31 JD
Cadmium	18		5.0	3.09 D	2.96 D	6.57 D	5.87 D	7.38 D	7.47 D	4.41 D	8.71 D	8.14 D	2.1 D
Calcium				46200	91000	177000 ☆	171000 ☆	172000 ☆	165000 ☆	57800	171000 ☆	175000 ☆	304000 ☆
Chromium	110		100	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U
Cobalt				0.5 U	7.33 D	22.3 D	23.5 D	24.7 D	27.3 D	59.1 D	26.7 D	25.6 D	34.9 D
Copper			1,300	25.2 D	26.1 D	147 D ☆	146 D ☆	175 D ☆	184 D ☆	229 D ☆	184 D ☆	191 D ☆	5 U
Iron				100 U	1980	12000	12200	14800	17600	32700	17200	17100	19300
Lead			15	0.62 JD	0.5 U	17.4 D ★	18.9 D ★	22.4 D ★	25.7 D ★	95.6 D ★	24.5 D ★	24.1 D ★	1 U
Magnesium				4060	5630	10900	10600	10900	11300	12600	11300	11600	18900 ☆
Manganese	5,100			120	2560 ☆	4580 ☆	4390 ☆	5280 ★	5610 ★	5010 ☆	5710 ★	5900 ★	8020 ★
Molybdenum	11		2.0	0.5 U	0.67 JD	0.5 U	0.9 JD	0.557 JD	0.5 U	0.5 U	0.5 U	0.5 U	1 U
Nickel	730			2.5 U	2.96 JD	11 D	11.7 D	12.7 D	12.9 D	33.2 D	12.9 D	12.2 D	5 U
Potassium				294 J	1010 ☆	1840 ☆	1780 ☆	1580 ☆	1680 ☆	1300 ☆	1680 ☆	1650 ☆	2450 ☆
Selenium	180		50	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U
Silver	180			0.5 U	0.5 U	0.5 U	0.891 JD	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U
Sodium				1230	3150	4550 ☆	4460 ☆	4310 ☆	4090 ☆	2180	4150 ☆	4280 ☆	9620 ☆
Thallium			0.50	2.5 U	2.5 U	2.5 U	6.35 D	4.02 JD	2.77 JD	2.5 U	2.5 U	2.5 U	5 U
Vanadium	260			5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U
Zinc	11,000			556	1030	2340 ☆	2260 ☆	2800 ☆	3000 ☆	1070	3090 ☆	3160 ☆	2450 ☆

TABLE 2 Surface Water Results														
Sample ID:				UASW030	UASW044	UASW045	UASW046	UASW047	UASW049	UASW050	UASW054	UASW056	UASW058	UASW059
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		Lower Ross Basin Drainage upstream of Grand Mogul Mine	Cement Creek upstream of the Anglo Saxon Mine and downstream of Minnesota Gulch drainage	Minnesota Gulch drainage	Cement Creek upstream of the confluence with Minnesota Gulch drainage	Cement Creek downstream of the Elk Tunnel and Fairview Gulch	Cement Creek upstream of the confluence with Fairview Gulch and the Elk Tunnel discharge	Cement Creek downstream of the Mammoth Tunnel	Prospect Gulch drainage	Cement Creek downstream of the Dry Gulch drainage	Cement Creek upstream of the confluence with Dry Gulch drainage	Cement Creek at the toe of Grand Mogul Mine
	RDSC	CRSC	MCL/MCLG	(Background)										
Analytes	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Aluminum				69	8150 ☆	4280 ☆	8340 ☆	8450 ☆	8900 ☆	8830 ☆	14400 ☆	5440 ☆	5510 ☆	13200 ☆
Antimony	15		6	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Arsenic	11	0.057	10	2.5 U	2.5 U	2.5 U	2.5 U	3.51 JD	5 JD	4.63 JD	17 D	2.5 U	2.5 U	26.9 D
Barium	2,600		2,000	30.8 JD	25 U	29 JD	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Beryllium	73		4.0	0.5 U	1.32 D	1.05 D	1.52 D	1.44 D	1.27 D	1.5 D	0.726 JD	1.75 D	1.52 D	0.94 JD
Cadmium	18		5.0	3.09 D	9.09 D	3.79 D	8.6 D	8.99 D	9.51 D ★	9.7 D ★	5.33 D	12.7 D ★	13.7 D ★	105 D ★
Calcium				46200	167000 ☆	52700	170000 ☆	170000 ☆	171000 ☆	169000 ☆	35400	178000☆	182000 ☆	17400
Chromium	110		100	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5.46 D
Cobalt				0.5 U	28.9 D	20.6 D	28.2 D	29.4 D	29.8 D	28.7 D	26.1 D	30.4 D	30.4 D	25.6 D
Copper			1,300	25.2 D	212 D ☆	150 D ☆	212 D ☆	225 D ☆	239 D ☆	235 D ☆	190 D ☆	355 D ☆	366 D ☆	4690 D ★
Iron				100 U	18200	268	20000	21800	24100	23900	27600	16000	15900	46400
Lead			15	0.62 JD	26 D ★	9.44 D ☆	24.8 D ★	24.7 D ★	25.4 D ★	25.3 D ★	57.3 D ★	26.8 D ★	27.9 D ★	33.8 D ★
Magnesium				4060	11200	9690	11300	11400	11800	11700	7560	12200 ☆	12600 ☆	12000
Manganese	5,100			120	5750 ★	1620 ☆	5780 ★	5860 ★	6180 ★	6240 ★	826 ☆	8750 ★	9150 ★	8740 ★
Molybdenum	11		2.0	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Nickel	730			2.5 U	14.9 D	13.6 D	13.2 D	14.4 D	15.3 D	15.2 D	19.6 D	12.2 D	12.6 D	16.4 D
Potassium				294 J	1650 ☆	714 J	1660 ☆	1680 ☆	1720 ☆	1700 ☆	2130 ☆	1100 ☆	1070 ☆	362 J
Selenium	180		50	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Silver	180			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium				1230	4030 ☆	1620	4030 ☆	3990 ☆	3870 ☆	3810 ☆	1230	4280 ☆	4370 ☆	626
Thallium			0.50	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Vanadium	260			5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Zinc	11,000			556	3210 ☆	907	3230 ☆	3320 ☆	3510 ☆	3560 ☆	1350	4850 ☆	5130 ☆	24900 ★

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The associated numerical value is an estimated quantity because quality control criteria wer

The analyte was not detected at or above the CRDL.

The reported quantitation limit is estimated because Quality Control criteria were not met.

The associated numerical value is an estimated quantity but the result may be biased low.

The analyte was identified in a sample at a secondary dilution factor

The analyte was detected at three times greater than the background concentration

The analyte was detected at three times greater than the background concentration and greater than an associated benchmark

Sources: EPA 2004 (SCDM)

TABLE 3
Sediment Results

Sample ID:				UASE030	UASE001	UASE002	UASE003	UASE004	USSE005	UASE006	UASE007	UASE008	UASE009
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		Lower Ross Basin Drainage upstream of Grand Mogul Mine	Animas River downstream of the confluence with Cement Creek	Cement Creek immediately upstream of the confluence with the Animas River	Animas River upstream of the confluence with Cement Creek	Cement Creek downstream of the confluence with the South Fork of Cement Creek	South Fork of Cement Creek	Cement Creek downstream of the American Tunnel and upstream of the confluence with the South Fork of Cement Creek	Discharge from the American Tunnel immediately above confluence with Cement Creek	Cement Creek upstream of the American Tunnel	Cement Creek downstream of the confluence with the North Fork of Cement Creek
Analytes	RDSC (mg/kg)	CRSC (mg/kg)	MCL/MCLG (mg/kg)	(Background) (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	-	-	47100	15700	6860	7030	8570	9570	8370	7030	13400	13700	4940
Antimony	-	-	-	1.2 U	2.1 UJ	1.4 UJ	1.3 UJ	1.3 UJ	1.3 UJ	2.8 J	5 UJ	1.7 UJ	2.7 UJ
Arsenic	-	-	94.5	31.5 J+	45.3 J	34.1 J	5.9 J	20.3 J	11.6 J	50.2 J	17.7 J	33.3 J	15.2 J
Barium	-	-	282.6	94.2 J+	559 J ☆	210 J	108 J	97.3	78.8	146	24.9 UJ	92.7	71.6
Beryllium	-	-	4.2	1.4 J+	1 UJ	0.72 U	1 J+	0.65 U	0.66 J+	0.95 U	2.5 U	1.1 J+	1.4 UJ
Cadmium	-	-	31.2	10.4 J	1 UJ	0.72 U	5.8 J	0.9	0.64 UJ	2.9	2.5 U	1.3 J	1.4 UJ
Calcium	-	-	5970	1990	1100	1010	2560	1530	1230	1420	2490 U	1660	1370 U
Chromium	-	-	24	8	6.6	6.4	6.5	7	6.2 J	8.4	5 U	7.6 J	6.4 J
Cobalt	-	-	61.5	20.5	3.9 J	4.3 J	10.9 J	11.8	6.5	3.9	2.5 U	16.5	6.8
Copper	-	-	3720	1240 J+	48.7 J	53 J	119 J	86.5	65 J	279	28.1	209 J	124 J
Iron	-	-	213600	71200	78100	68800	20800	57600	34800	114000	238000 ☆	37300	159000
Lead	-	-	4440	1480 J	459	322	612	726 J	145	5720 J ☆	217 J	711	341
Magnesium	-	-	34500	11500	3030	4080	5610	6070	1460	3810	913	8730	1370 U
Manganese	-	-	19800	6600	333	506	6750	1530	839 J	1340	336	4130 J	2010 J
Nickel	-	-	35.1	11.7 J	3.4 J	4 J	8.2 J	4.4	4.2 J	3.8	1.3	8 J	2.2 J
Potassium	-	-	1926	642 J+	1700 J+	889 J+	745 J+	751 J+	902 J+	1560 J+	231 J+	825 U	1370 U
Selenium	-	-	-	3 U	1.6 J	0.81 J	0.099 J	3.3 UJ	3.2 UJ	4.8 UJ	12.4 UJ	4.1 UJ	6.9 UJ
Silver	-	-	3.6	1.2 J	4.5 J+ ☆	2.5 J+	1.5 J+	1.7 J+	0.64 UJ	12.1 J+ ☆	2.5 UJ	2.1 J	4 J
Sodium	-	-	1800	600 UJ	1040 U	723 U	641 U	62.3 J+	640 U	118 J+	44.5 J+	825 U	1370 U
Thallium	-	-	1.32	0.44 J-	1 U	0.72 U	0.64 U	0.39 J+	0.64 UJ	0.6 J+	2.5 UJ	0.83 UJ	1.4 UJ
Vanadium	-	-	122.7	40.9	49.7	44.8	30.6	47.3	52.2	47.7	41.8	64.1	27.3
Zinc	-	-	4500	1500 J	205 J	199 J	1470 J	261 J	145 J-	815 J	269 J	289 J-	242 J-

Sample ID:				UASE030	UASE010	UASE011	UASE012	UASE013	UASE014	UASE015	UASE016	UASE017	UASE018
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		Lower Ross Basin Drainage upstream of Grand Mogul Mine	North Fork of Cement Creek upstream of the confluence with Cement Creek	North Fork of Cement Creek downstream of the Gold King 7 Level Mine - at road crossing	North Fork of Cement Creek upstream of the Gold King 7 Level Mine	Cement Creek upstream of the confluence with the North Fork of Cement Creek	Cement Creek downstream of Red and Bonita Mine	Drainage channel adjacent to county road below Red and Bonita	Cement Creek upstream of Red and Bonita Mine	Cement Creek downstream of wetland that channels Mogul Mine drainage	Cement Creek upstream of wetland that contains Mogul Mine drainage
Analytes	RDSC (mg/kg)	CRSC (mg/kg)	MCL/MCLG (mg/kg)	(Background) (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	-	-	47100	15700	9330	2020	10900	4520	3850	4670	8140	8100	13100
Antimony	-	-	-	1.2 U	1.3 UJ	2.8 UJ	1.3 UJ	2.8 UJ	3 UJ	2.3 J	3.2 UJ	1.3 UJ	1.3 UJ
Arsenic	-	-	94.5	31.5 J+	26.2 J	36.7 J	17.3 J	20.5 J	24.5 J	23.2 J	57.5 J	17.7 J	28.1 J
Barium	-	-	282.6	94.2 J+	51.8	30.7	102	61.9	36.1	46.5	200	121	90.8
Beryllium	-	-	4.2	1.4 J+	0.64 UJ	1.4 UJ	0.63 U	1.4 UJ	1.5 UJ	1.1 UJ	1.6 UJ	0.63 U	0.73 J+
Cadmium	-	-	31.2	10.4 J	0.64 UJ	0.11	0.63 U	1.4 UJ	1.5 UJ	2.4 J	1.6 UJ	0.63 U	2
Calcium	-	-	5970	1990	1710	1380 U	1890	1410 U	1500 U	1130	1940	1740	2020
Chromium	-	-	24	8	9.1 J	5.1 J	8	4.3 J	6.1 J	4 J	11.9 J	6.9	9
Cobalt	-	-	61.5	20.5	4.3	2.8 U	10.4	6	3 U	2.2 U	23.7	13.2	11.2
Copper	-	-	3720	1240 J+	42.8 J	113 J	73.1	84 J	147 J	112 J	250 J	63.6	193
Iron	-	-	213600	71200	18200	397000 ☆	37100	203000	218000 ☆	442000 ☆	65400	38100	35000
Lead	-	-	4440	1480 J	294	136	532 J	362	773	457	1460	379 J	543 J
Magnesium	-	-	34500	11500	8680	1380 U	5380	1410 U	1500 U	1120 U	2260	5830	8970
Manganese	-	-	19800	6600	624 J	156 J	675	1910 J	489 J	239 J	2360 J	1420	3650
Nickel	-	-	35.1	11.7 J	4.1 J	1.4 UJ	7.1	1.6 J	2 J	1.1 UJ	12.3 J	6.3	5.2
Potassium	-	-	1926	642 J+	638 U	1380 U	1000 J+	1410 U	1500 U	1120 U	1580 U	440 J+	501 J+
Selenium	-	-	-	3 U	3.2 UJ	6.9 UJ	3.1 UJ	7.1 UJ	7.5 UJ	5.6 UJ	7.9 UJ	3.1 UJ	3.3 UJ
Silver	-	-	3.6	1.2 J	0.88 J	1.4 UJ	1.3 J+	2.3 J	8.5 J ☆	3.9 J ☆	1.6 UJ	1.3 J+	1.7 J+
Sodium	-	-	1800	600 UJ	638 U	1380 U	99.3 J+	1410 U	1500 U	1120 U	1580 U	30.8 J+	21.9 J+
Thallium	-	-	1.32	0.44 J-	0.64 UJ	1.4 UJ	0.35 J+	1.4 UJ	1.5 UJ	1.1 UJ	1.6 UJ	0.3 J+	0.4 J+
Vanadium	-	-	122.7	40.9	29.1	27.8	49	29.7	34	31.7	62	46.3	32.2
Zinc	-	-	4500	1500 J	145 J-	44.1 J-	73.8 J	240 J-	465 J-	1040 J-	378 J-	184 J	332 J

TABLE 3
Sediment Results

Sample ID:				UASE030	UASE019	UASE020	UASE021	UASE022	UASE023	UASE024	UASE029	UASE032	UASE033
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		Lower Ross Basin Drainage upstream of Grand Mogul Mine	Mogul Mine drainage (in wetland)	Cement Creek upstream of Mogul Mine	Cement Creek downstream of Mogul North Mine	Mogul North Mine discharge	Cement Creek upstream of Mogul North Mine and downstream of confluence with Lower Ross	Cement Creek downstream of Queen Anne Mine and upstream of confluence with Lower Ross	Animas River Below Silverton	Animas River downstream of the confluence with Mineral Creek	Mineral Creek upstream of the confluence with the Animas River
Analytes	RDSC (mg/kg)	CRSC (mg/kg)	MCL/MCLG (mg/kg)	(Background) (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	-	-	47100	15700	5960	12200	13600	6720	3020	11500	12300	8000	28200
Antimony	-	-	-	1.2 U	1.6 UJ	1.4 UJ	1.3 U	6.8 U	1.7 J	1.7 U	1.6 UJ	1.3 UJ	3.5 UJ
Arsenic	-	-	94.5	31.5 J+	62.5 J	36.8 J	25.8 J+	42.6 J+	45.6 J+	49.4 J+	27.3 J	14.2 J	26.7 J
Barium	-	-	282.6	94.2 J+	121	147	74.3 J+	119 J+	264 J+	205 J+	261 J	79.3 J	159
Beryllium	-	-	4.2	1.4 J+	0.8 U	1.4 J+	1.3 J+	3.4 UJ	1.3 J+	1.3 J+	0.89 J+	0.75 J+	1.7 UJ
Cadmium	-	-	31.2	10.4 J	1.4	7.4	6 J	3.4 UJ	6 J	7 J	2 J	0.97 J	1.7 UJ
Calcium	-	-	5970	1990	804 U	1110	1310	3380 U	718 U	1280	2010	2050	1950
Chromium	-	-	24	8	8.5	9.6	7.1	19.7	6.2	8.2	5.6	6.9	5.1 J
Cobalt	-	-	61.5	20.5	5.4	12.9	12.3	4.8	15.3	15.8	12.3 J	11 J	18.6
Copper	-	-	3720	1240 J+	177	546	516 J+	303 J+	424 J+	294 J+	167 J	201 J	216 J
Iron	-	-	213600	71200	116000	31900	37200	141000	5150	27100	58100	26000	62200
Lead	-	-	4440	1480 J	546 J	779 J	481 J	668 J	2030 J	754 J	734	187	210
Magnesium	-	-	34500	11500	3260	5340	7200	3380 U	1090	5670	4270	3730	2280
Manganese	-	-	19800	6600	1130	5130	4710	1180	7960	11500	2710	1160	897 J
Nickel	-	-	35.1	11.7 J	4.5	6.9	10.3 J	5.9 J	7.7 J	7.8 J	5.2 J	5.9 J	6 J
Potassium	-	-	1926	642 J+	842 J+	648 J+	664 U	3380 U	718 U	1210 J+	1260 J+	674 U	1740 U
Selenium	-	-	-	3 U	4 UJ	3.5 UJ	3.3 U	17 U	3.6 U	4.3 U	0.52 J	0.45 J	8.7 UJ
Silver	-	-	3.6	1.2 J	5.1 J+ ☆	2.8 J+	2 J	27.1 J ☆	11.8 J ☆	4 J ☆	2.8 J+	0.67 U	1.7 UJ
Sodium	-	-	1800	600 UJ	65.3 J+	29.5 J+	664 UJ	3380 U	718 UJ	855 UJ	814 U	674 U	1740 U
Thallium	-	-	1.32	0.44 J-	0.3 J+	0.4 J+	0.41 J-	0.31 J-	0.77	0.88	0.81 U	0.67 U	1.7 UJ
Vanadium	-	-	122.7	40.9	42.6	33.2	20.8	27.8	27.8	38	41.1	36.1	31.3
Zinc	-	-	4500	1500 J	444 J	1990 J	651 J	350 J	614 J	899 J	447 J	289 J	339 J-

Sample ID:				UASE030	UASE034	UASE035	UASE036	UASE037	UASE039	UASE040	UASE041	UASE042	UASE043
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		Lower Ross Basin Drainage upstream of Grand Mogul Mine	Animas River upstream of the confluence with Mineral Creek	Cement Creek downstream of the Kendrick-Gelder Smelter	Cement Creek upstream of the Kendrick-Gelder Smelter	Cement Creek downstream of the Illinois Gulch drainage	Cement Creek upstream of the confluence with Illinois Gulch drainage and downstream of Ohio Gulch drainage	Ohio Gulch drainage	Cement Creek upstream of the confluence with Ohio Gulch drainage	Cement Creek downstream of the Anglo Saxon Mine drainage	Anglo Saxon Mine drainage
Analytes	RDSC (mg/kg)	CRSC (mg/kg)	MCL/MCLG (mg/kg)	(Background) (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	-	-	47100	15700	11600	5900	7040	4890	5540	5240	8220	5710	5060
Antimony	-	-	-	1.2 U	1.7 UJ	1.6 UJ	1.4 UJ	1.6 UJ	1.4 UJ	1.3 UJ	1.5 UJ	1.9 UJ	2.5 UJ
Arsenic	-	-	94.5	31.5 J+	13.3 J	41.7 J	35.3 J	57 J	34 J	54.8 J	34.3 J	37.2 J	103 J
Barium	-	-	282.6	94.2 J+	123 J	424 J ☆	342 J ☆	317 J ☆	422 J ☆	582 J ☆	121 J	258 J	36.3 J
Beryllium	-	-	4.2	1.4 J+	0.87 U	0.78 U	0.68 U	0.82 U	0.71 U	0.64 U	0.74 U	0.93 U	10.3 J+ ☆
Cadmium	-	-	31.2	10.4 J	0.87 U	0.83 J	1.4 J	0.82 U	0.71 U	2.6 J	0.51	0.93 U	4.1 J
Calcium	-	-	5970	1990	1810	934	1040	822 U	735	644 U	1040	1040	4130
Chromium	-	-	24	8	4.7	5.2	5.7	4.8	5.9	4.5	6.6	8.4	2.5 U
Cobalt	-	-	61.5	20.5	5.4 J	3.8 J	4.8 J	3.6 J	3.1 J	4 J	5.5 J	4.4 J	17 J
Copper	-	-	3720	1240 J+	91.4 J	42.7 J	98.6 J	41.8 J	29.8 J	40.4 J	55.2 J	59.7 J	110 J
Iron	-	-	213600	71200	44300	71700	62200	88900	56500	44400	94600	123000	860000 ☆
Lead	-	-	4440	1480 J	366	394	306	541	361	598	334	417	255
Magnesium	-	-	34500	11500	6090	2440	3760	2180	2810	2570	4550	2360	1240 U
Manganese	-	-	19800	6600	1440	421	580	436	311	304	831	636	2410
Nickel	-	-	35.1	11.7 J	3.9 J	3.1 J	3.4 J	3.2 J	2.8 J	3.3 J	3.9 J	3.6 J	3.3 J
Potassium	-	-	1926	642 J+	865 U	1300 J+	1090 J+	1200 J+	1270 J+	1230 J+	1060 J+	1410 J+	1240 U
Selenium	-	-	-	3 U	0.51 J	1.5 J	1 J	1.4 J	1.3 J	2 J	0.81 J	2.1 J	0.21 J
Silver	-	-	3.6	1.2 J	1.2 J+	2.4 J+	1.4 J+	2.1 J+	1.9 J+	3.6 J+ ☆	1.4 J+	2.2 J+	1.2 U
Sodium	-	-	1800	600 UJ	865 U	781 U	676 U	822 U	714 U	644 U	741 U	926 U	1240 U
Thallium	-	-	1.32	0.44 J-	0.87 U	0.78 U	0.68 U	0.82 U	0.71 U	0.64 U	0.74 U	0.99 J+	1.2 U
Vanadium	-	-	122.7	40.9	25.8	40.7	42.3	48.6	34.6	36.4	49.9	71.7	13.4
Zinc	-	-	4500	1500 J	241 J	197 J	360 J	153 J	136 J	604 J	186 J	225 J	2470 J

TABLE 3
Sediment Results

Sample ID:				UASE030	UASE044	UASE045	UASE046	UASE047	UASE049	UASE050	UASE054	UASE056	UASE058	UASE059
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		Lower Ross Basin Drainage upstream of Grand Mogul Mine	Cement Creek upstream of the Anglo Saxon Mine and downstream of Minnesota Gulch drainage	Minnesota Gulch drainage	Cement Creek upstream of the confluence with Minnesota Gulch drainage	Cement Creek downstream of the Elk Tunnel and Fairview Gulch	Cement Creek upstream of the confluence with Fairview Gulch and the Elk Tunnel discharge and downstream of Georgia Gulch	Cement Creek upstream of Georgia Gulch and downstream of the Mammoth Tunnel	Prospect Gulch drainage	Cement Creek downstream of the Dry Gulch drainage	Cement Creek upstream of the confluence with Dry Gulch drainage	Cement Creek at the toe of Grand Mogul Mine
Analytes	RDSC (mg/kg)	CRSC (mg/kg)	MCL/MCLG (mg/kg)	(Background) (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Aluminum	-	-	47100	15700	8860	10400	5070	6160	7840	6640	3730	6730	5750	986
Antimony	-	-	-	1.2 U	1.3 UJ	1.4 UJ	3.8 UJ	1.6 UJ	1.3 UJ	1.6 UJ	1.3 UJ	2.2 UJ	2.7 UJ	23.3 J
Arsenic	-	-	94.5	31.5 J+	34 J	46.9 J	115 J ☆	24.3 J	37.7 J	34.7 J	58.9 J	20.3 J	35.6 J	969 J+ ☆
Barium	-	-	282.6	94.2 J+	191 J	314 J ☆	80.6 J	226 J	95.5 J	250 J	144	142	85.9	37.1 J+
Beryllium	-	-	4.2	1.4 J+	0.66 U	0.96 J+	1.9 U	0.78 U	0.64 U	0.81 U	0.63 UJ	1.1 UJ	1.4 UJ	3 UJ
Cadmium	-	-	31.2	10.4 J	2 J	0.68 U	1.9 U	0.78 U	17.5 J	2.7 J	0.77 J	1.1 UJ	2.7 J	3 UJ
Calcium	-	-	5970	1990	2020	1350	1900 U	867	1120	1050	627 U	1100 U	1370 U	2980 U
Chromium	-	-	24	8	7	7.8	6.2	6.9	7.9	9.9	4.8 J	6.4 J	8 J	11.3
Cobalt	-	-	61.5	20.5	5.5 J	14.8 J	2.1 J	2.9 J	9.3 J	6.4 J	4	3.2	4.7	3 UJ
Copper	-	-	3720	1240 J+	76.4 J	77.1 J	112 J	47.8 J	159 J	60 J	64.9 J	80.7 J	212 J	235 J+
Iron	-	-	213600	71200	67200	37000	341000 ☆	57100	33000	81600	53500	144000	266000 ☆	273000 ☆
Lead	-	-	4440	1480 J	361	342	1700	304	847	346	254	875	2050	1100 J
Magnesium	-	-	34500	11500	5080	3850	2130	2360	6800	3090	2030	2820	2370	2980 U
Manganese	-	-	19800	6600	804	1560	540	407	1200	1380	406 J	659 J	1300 J	304
Nickel	-	-	35.1	11.7 J	3.6 J	7.5 J	2.3 J	2.8 J	7.1 J	4.7 J	1.9 J	2.9 J	2.5 J	3 UJ
Potassium	-	-	1926	642 J+	933 J+	1310 J+	1900 U	1350 J+	636 U	1230 J+	627 U	1250 J+	1370 U	2980 U
Selenium	-	-	-	3 U	1.1 J	1.1 J	0.63 J	2 J	0.92 J	2	3.1 UJ	5.5 UJ	6.9 UJ	15 U
Silver	-	-	3.6	1.2 J	1.4 J+	1.5 J+	4.1 J+ ☆	1.9 J+	2.9 J+	1.7 J+	0.95 J	2.3 J	5 J ☆	13.2 J ☆
Sodium	-	-	1800	600 UJ	657 U	684 U	1900 U	782 U	636 U	813 U	627 U	1100 U	1370 U	2980 UJ ☆
Thallium	-	-	1.32	0.44 J-	0.66 U	0.75 J+	1.9 U	0.8 J+	0.64 U	0.9 J+	0.63 UJ	1.1 UJ	1.4 UJ	0.19 J-
Vanadium	-	-	122.7	40.9	45.2	48.6	96.9	56.3	65.9	72.2	36.5	62	37.2	57.1
Zinc	-	-	4500	1500 J	478 J	144 J	177 J	131 J	4910 J ☆	693 J	192 J-	206 J-	628 J	524 J

J

The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable.

U

The analyte was not detected at or above the CRDL.

UJ

The reported quantitation limit is estimated because Quality Control criteria were not met. Element may not be present the sample.

J-

The associated numerical value is an estimated quantity but the result may be biased low.

D

The analyte was identified in a sample at a secondary dilution factor

☆

The analyte was detected at three times greater than the background concentration

TABLE 4
Soil Sample Results

Field Sample ID:			UASO001	UASO002	UASO003	UASO004	UASO005	UASO006	UASO007	UASO008	UASO009	UASO010	UASO011	UASO012	UASO013	UASO014
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)	American Tunnel	American Tunnel	Red and Bonita Mine – top pile	Red and Bonita Mine – middle pile	Red and Bonita Mine – bottom pile	Mogul North Mine waste pile	Grand Mogul stope – west side	Grand Mogul stope – east side	Grand Mogul Mine waste piles – east side	Grand Mogul Mine waste piles – center	Grand Mogul Mine waste piles – west side	Mogul Mine waste piles – west side	Mogul Mine waste piles – adjacent to shed	Mogul Mine waste piles – east side
	(mg/kg)	CRSC (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Analyses																
Aluminum		-	13900	12900	8780	1470	2260	1130	1450	2020	11200	665	13000	906	3270	19500
Antimony	31		1.3 UJ	1.2 UJ	1.8 J	1.3 U	12 J	13.5 J	11.7 J	1.1 U	1.1 U	12.2 J	1.1 U	1.1 U	3.6 J	1.2 U
Arsenic	23	0.43	23.7 J	13.5 J	9.1 J+	15.7 J+	29.3 J+	34.9 J+	38.6 J+	90.2 J+	96.8 J+	55.2 J+	32.8 J+	13.6 J+	37.7 J+	31.9 J+
Barium	5,500		117	113	105 J+	18.7 J+	68.3 J+	83.8 J+	97.2 J+	72.1 J+	34.9 J+	81.3 J+	46.1 J+	37.1 J+	68.4 J+	154 J+
Beryllium	160		0.64 UJ	0.6 UJ	0.6 UJ	0.65 UJ	0.78 UJ	0.56 UJ	0.55 UJ	0.57 UJ	0.55 UJ	0.54 UJ	0.54 UJ	0.55 UJ	0.55 UJ	0.79 J+
Cadmium	39		9.6 J	0.6 UJ	0.63 J	0.65 UJ	35.4 J	5 J	7.6 J	1.1 J	0.55 UJ	40 J	0.7 J	0.55 UJ	9 J	3.7 J
Calcium			5910	2080	1780	648 U	775 U	563 U	551 U	807	1360	535 U	2030	554 U	547 U	1540
Chromium	230		8.4 J	10 J	4.9	1.8	2.2	1.3	1.1 U	2.3	11.9	1.1 U	10	1.1 U	2.7	9.9
Cobalt			8		1.3	1	0.78 U	0.56 U	0.55 U	0.88	5.5	0.54 U	4.6	0.55 U	1.5	21.4
Copper			244 J	40.6 J	195 J+	104 J+	286 J+	211 J+	471 J+	111 J+	47.1 J+	4600 J+	33.1 J+	63.1 J+	285 J+	162 J+
Iron			47800	36900	102000	150000	308000	8170	16900	21500	36000	22200	25200	7700	46300	55900
Lead			1820	241	6440 J	1850 J	5080 J	3880 J	4920 J	4510 J	1030 J	15500 J	2260 J	1050 J	3170 J	1070 J
Magnesium			11200	10700	5600	648 U	775 U	563 U	551 U	950	11100	535 U	12700	554 U	1920	9940
Manganese	11,000		1180 J	796 J	452	630	136	423	122	852	1620	177	3280	135	433	5570
Nickel	1600		5.8 J	6.6 J	2.3 J	1.3 J	0.78 UJ	0.56 UJ	0.55 UJ	0.74 J	5.3 J	0.54 UJ	5.3 J	0.55 UJ	1.4 J	9.5 J
Potassium			1070 J+	1030 J+	790 J	648 U	775 U	714 J+	1240 J+	1460 J+	872 J+	1200 J+	671 J+	961 J+	769 J+	1090 J+
Selenium	390		3.2 UJ	3 UJ	3 U	3.2 U	3.9 U	2.8 U	2.8 U	2.8 U	2.8 U	3.4	2.7 U	2.8 U	3 U	
Silver	390		5.4 J	1.3 J	103 J	10.4 J	27.5 J	34.6 J	54 J	8.4 J	5.7 J	113 J	4.6 J	6.9 J	22.9 J	2.7 J
Sodium			640 U	605 U	775 U	604 UJ	648 U	563 UJ	551 UJ	569 UJ	552 UJ	535 UJ	541 UJ	554 UJ	547 UJ	597 UJ
Thallium			0.64 UJ	0.6 UJ	0.5	0.23 J-	0.1 J-	0.61	0.85	1.2	0.36 J-	0.73	0.38 J-	0.43 J-	0.37 J-	0.56
Vanadium	550		53.6	65.3	26	23.7	49.7	7.8	12	17.5	62.1	7.1	60.8	4.9	15.4	47.5
Zinc	23,000		2610 J-	102 J-	167 J	265 J	11300 J	1400 J	2100 J	319 J	187 J	10400 J	210 J	140 J	2580 J	498 J

J	The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable.
U	The analyte was not detected at or above the CRDL.
UJ	The reported quantitation limit is estimated because Quality Control criteria were not met. Element may not be present in the sample.
J-	The associated numerical value is an estimated quantity but the result may be biased low.
J+	The associated numerical value is an estimated quantity but the result may be biased high
[]	The associated numerical value was detected below the CRDL, but greater than the method detection limit and is therefore an estimate (qualified by laboratory).

TABLE 5
Adit Sediment Sample Results

Field Sample ID:				UAAD001	UAAD002	UAAD003	UAAD004	UAAD001	UAAD002	UAAD003	UAAD004
Location:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		American Tunnel discharge (at portal)	Upper Gold King 7 Level Mine adit discharge	Red and Bonita Mine adit discharge	Mogul Mine adit discharge	American Tunnel discharge (at portal)	Upper Gold King 7 Level Mine adit discharge	Red and Bonita Mine adit discharge	Mogul Mine adit discharge
	RDSC	CRSC	MCL/MCLG								
				Total Metals	Total Metals	Total Metals	Total Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals
Analytes	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Aluminum				5520	18500	4680	3330	4990	18300	4620	3300
Antimony	15		6	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.5 U
Arsenic	11	0.057	10	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.72 JD
Barium	2,600		2,000	50 U	50 U	50 U	50 U	50 U	50 U	50 U	25 U
Beryllium	73		4.0	4.18 D	7.03 D	8.4 D	4.82 D	3.7 D	5.98 D	6.45 D	4.49 D
Cadmium	18		5.0	1.97 JD	54.9 D	53.1 D	55 D	2.02 D	53 D	48.7 D	50.9 D
Calcium				457000	398000	441000	212000	434000	395000	442000	211000
Chromium	110		100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.5 U
Cobalt				133 D	79.1 D	97.4 D	22.3 D	136 D	84.4 D	102 D	22.5 D
Copper			1,300	5 U	4030 D	5 U	15.3 D	5 U	4210 D	5 U	20.9 D
Iron				144000	73700	102000	31900	133000	71600	101000	27200
Lead			15	3.7 D	6.82 D	107 D	271 D	1.12 JD	5.66 D	98.7 D	255 D
Magnesium				31600	22800	28700	13200	29900	22600	28600	13200
Manganese	5,100			44000	28000	30700	28700	41700	27800	30500	29100
Molybdenum	11		2.0	1 U	1 U	1 U	1 U	UJ	1 UJ	1.54 JD	1.99 JD
Nickel	730			46.3 D	31.2 D	38.2 D	6.74 JD	47.8 D	35.4 D	42.6 D	8.3 D
Potassium				1790	1810	1860	2040	1680	1790	1840	2000
Selenium	180		50	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.5 U
Silver	180			1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U
Sodium				9610	5350	8730	6280	9080	5260	8530	6210
Thallium			0.50	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.5 U
Vanadium	260			10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U
Zinc	11,000			19100	18700	15500	31300	18100	18600	15400	32700

J The associated numerical value is an estimated quantity because quality control c:
U The analyte was not detected at or above the CRDL.
UJ The reported quantitation limit is estimated because Quality Control criteria were
J- The associated numerical value is an estimated quantity but the result may be bias
D The analyte was identified in a sample at a secondary dilution factor

Sources: EPA 2004 (SCDM)

TABLE 6
Adit Sediment Results

Field Sample ID:	Superfund Chemical Data Matrix (SCDM)	Superfund Chemical Data Matrix (SCDM)		UAAD001 American Tunnel discharge (at portal)	UAAD002 Upper Gold King 7 Level Mine adit discharge	UAAD003 Red and Bonita Mine adit discharge	UAAD004 Mogul Mine adit discharge
Location:	RDSC (mg/kg)	CRSC (mg/kg)	MCL/MCLG (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Analytes							
Aluminum	-	-	-	5480	3170	4960	2320
Antimony	-	-	-	3.2 UJ	2.9 UJ	5.6 J	3.1 UJ
Arsenic	-	-	-	19.1 J	43.9 J	126 J	49.1 J
Barium	-	-	-	17.4	3.5	21.4	41.3
Beryllium	-	-	-	1.6 U	1.5 UJ	1.7 UJ	1.5 UJ
Cadmium	-	-	-	1.6 U	1.5 UJ	1.7 UJ	1.5 UJ
Calcium	-	-	-	1580 U	1490	1820	1530 U
Chromium	-	-	-	3.2 U	2.9 UJ	7.4 J	2.2 J
Cobalt	-	-	-	1.6 UJ	2.9 UJ	3.4 U	16.6
Copper	-	-	-	20.2	11 J	369 J	32.8 J
Iron	-	-	-	359000	445000	519000	462000
Lead	-	-	-	115 J	1740	59.4	419
Magnesium	-	-	-	644	1460 U	1680 U	1530 U
Manganese	-	-	-	280	107 J	130 J	2110 J
Nickel	-	-	-	1.6 U	1.5 UJ	1.7 UJ	1.7 J
Potassium	-	-	-	146 J+	1460 U	1680 U	1530 U
Selenium	-	-	-	7.9 UJ	7.3 UJ	8.4 UJ	7.6 UJ
Silver	-	-	-	1.6 UJ	1.5 UJ	1.7 UJ	1.5 UJ
Sodium	-	-	-	31.2 J+	1460 U	1680 U	1530 U
Thallium	-	-	-	1.6 J+	1.5 UJ	1.7 UJ	1.5 UJ
Vanadium	-	-	-	45.9	12.4	88	12
Zinc	-	-	-	282 J	361 J-	63.3 J-	232 J-

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable.

U The analyte was not detected at or above the CRDL.

UJ The reported quantitation limit is estimated because Quality Control criteria were not met. Element may not be present the sample.

J- The associated numerical value is an estimated quantity but the result may be biased low.

J+ The associated numerical value is an estimated quantity but the result may be biased high

[] The associated numerical value was detected below the CRDL, but greater than the method detection limit and is therefore an estimate (qualified by laboratory).

TABLE 7
PRD Results

Analyte	UASW005 Surface Water: South Fork of Cement Creek	UASW098 Duplicate of UASW005	RPD	UASE005 Sediment: South Fork of Cement Creek	UASE098 Duplicate of UASE005	RPD
Aluminum	720	572	22.9	8370	5550	40.5
Antimony	2.5 U	2.5 U	NA	1.3 UJ	1.5 U	NA
Arsenic	2.5 U	2.5 U	NA	11.6 J	11.7 J+	0.9
Barium	25 U	25 U	NA	78.8	190 J+	82.7
Beryllium	0.5 U	0.5 U	NA	0.66 J+	0.76 UJ	14.1
Cadmium	2.73 D	2.41 D	12.5	0.64 UJ	0.76 UJ	17.1
Calcium	162000	163000	0.6	1230	1500	19.8
Chromium	2.5 U	2.5 U	NA	6.2 J	4.8	25.5
Cobalt	7.71 D	7.36 D	4.6	6.5	4.3	40.7
Copper	8.83 D	6.5 D	30.4	65 J	34.5 J+	61.3
Iron	3230	3090	4.4	34800	30000	14.8
Lead	0.643 JD	0.5 U	NA	145	72.5 J	66.7
Magnesium	8230	8340	1.3	1460	2560	54.7
Manganese	1840	1860	1.1	839 J	568	38.5
Molybdenum	0.535 JD	0.5 U	NA	--	--	--
Nickel	2.5 U	2.5 U	NA	4.2 J	3.9 J	7.4
Potassium	747 J	752 J	0.7	902 J+	934 J+	3.5
Selenium	2.5 U	2.5 U	NA	3.2 UJ	3.8 U	NA
Silver	0.5 U	0.5 U	NA	0.64 UJ	0.76 UJ	17.1
Sodium	3470	3520	1.4	640 U	761 UJ	NA
Thallium	2.5 U	2.5 U	NA	0.64 UJ	0.52	20.7
Vanadium	5 U	5 U	NA	52.2	45.2	14.4
Zinc	647	661	2.1	145 J-	99 J	37.7

Analyte	UASW019 Surface Water: Mogul Mine Drainage (in wetland)	UASW099 Duplicate of UASW019	RPD	UASE019 Sediment: South Fork of Cement Creek	UASE099 Duplicate of UASE019	RPD
Aluminum	10100	10200	1.0	5960	8140	30.9
Antimony	2.5 U	2.5 U	NA	1.6 UJ	2 UJ	22.2
Arsenic	2.5 U	2.5 U	NA	62.5 J	86.3 J	32.0
Barium	25 U	25 U	NA	121	168	32.5
Beryllium	3.8 D	3.96 D	4.1	0.8 U	1 U	NA
Cadmium	72.8 D	74.2 D	1.9	1.4	1.2	15.4
Calcium	174000	174000	0.0	804 U	1030 U	NA
Chromium	2.5 U	2.5 U	NA	8.5	9.8	14.2
Cobalt	22.6 D	22.6 D	0.0	5.4	6.1	12.2
Copper	820 D	848 D	3.4	177	251	34.6
Iron	4460	4570	2.4	116000	154000	28.1
Lead	75.6 D	76.6 D	1.3	546 J	656 J	18.3
Magnesium	13600	13700	0.7	3260	4670	35.6
Manganese	21900	22000	0.5	1130	1400	21.3
Molybdenum	0.5 U	0.5 U	NA	--	--	--
Nickel	13.6 D	13.7 D	0.7	4.5	4.8	6.5
Potassium	1420	1440	1.4	842 J+	1120 J+	28.3
Selenium	2.5 U	2.5 U	NA	4 UJ	5.1 UJ	24.2
Silver	0.5 U	0.5 U	NA	5.1 J+	7.5 J+	38.1
Sodium	5520	5560	0.7	65.3 J+	98.1 J+	40.1
Thallium	2.5 U	2.5 U	NA	0.3 J+	0.31 J+	3.3
Vanadium	5 U	5 U	NA	42.6	44.3	3.9
Zinc	27600	27700	0.4	444 J	464 J	4.4

Analyte	UASW035 Surface Water: Mineral Creek downstream of Kendrick-Gelder Smelter	UASW097 Duplicate of UASW035	RPD	UASE035 Sediment: South Fork of Cement Creek	UASE097 Duplicate of UASE035	RPD
Aluminum	7890	7870	0.3	5900	4750	21.6
Antimony	2.5 U	2.5 U	NA	1.6 UJ	1.6 UJ	0.0
Arsenic	2.5 U	2.5 U	NA	41.7 J	44.2 J	5.8
Barium	25 U	25 U	NA	424 J	443	4.4
Beryllium	1.14 D	1.3 D	13.1	0.78 U	0.79 UJ	NA
Cadmium	6.57 D	6.45 D	1.8	0.83 J	0.79 UJ	4.9
Calcium	177000	175000	1.1	934	854	8.9
Chromium	2.5 U	2.5 U	NA	5.2	4.6 J	12.2
Cobalt	22.3 D	21.6 D	3.2	3.8 J	3.5	8.2
Copper	147 D	135 D	8.5	42.7 J	35.8 J	17.6
Iron	12000	11700	2.5	71700	73000	1.8
Lead	17.4 D	19 D	8.8	394	372	5.7
Magnesium	10900	10900	0.0	2440	1890	25.4
Manganese	4580	4810	4.9	421	344 J	20.1
Molybdenum	0.5 U	0.5 U	NA	--	--	--
Nickel	11 D	9.52 D	14.4	3.1 J	2.7 J	13.8
Potassium	1840	1800	2.2	1300 J+	1150 J+	12.2
Selenium	2.5 U	2.5 U	NA	1.5 J	4 UJ	90.9
Silver	0.5 U	0.5 U	NA	2.4 J+	2.2 J	8.7
Sodium	4550	4580	0.7	781 U	795 U	NA
Thallium	2.5 U	2.5 U	NA	0.78 U	0.79 UJ	NA
Vanadium	5 U	5 U	NA	40.7	37.2	9.0
Zinc	2340	2500	6.6	197 J	179 J-	9.6

Average Surface Water RPD

4.3

Average Sediment RPD

22.5